LAN / CBX TRENDS: DECISION PROCESSES FOR USERS

INPUT

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Offices

NORTH AMERICA

Headquarters
1943 Landings Drive
Mountain View, CA
94043
(415) 960-3990
Telex 171407

Detroit
220 East Huron
Suite 209
Ann Arbor, MI 48104
(313) 971-0667

New York
Park 80 Plaza West-1
Saddle Brook, NJ 07662
(201) 368-9471
Telex 134630

Washington, D.C.
11820 Parklawn Drive
Suite 201
Rockville, MD 20852
(301) 231-7350

EUROPE

United Kingdom
INPUT, Ltd.
Airwork House
35 Piccadilly
London, W1V 9PB
England
01-439-8985
Telex 23116

France
La Nacelle
Procedure d'abonnement 1-74
2, rue Campagne Premiere
75014 Paris
France
322.56.46
Telex 220064 X5533

Italy
PGP Sistema SRL
20127 Milano
Via Soperga 36
Italy
Milan 284-2850
Telex 310352

Sweden
Athena Konsult
P.O. Persson & Co. AB
Box 22114
S-104 22 Stockholm
Sweden
08-52 07 20
Telex 17041

West Germany
NOVOTRON GmbH
Am Elizabethenbrunnen 1
D-6380 Bad Homburg
West Germany
(06172) 44402
Telex 418094

ASIA/AUSTRALIA

Japan
Overseas Data Service
Company, Ltd.
Shugetsu Building
No. 12-7 Kita Aoyama
3-Chome Minato-ku
Tokyo, 107
Japan
(03) 400-7090
Telex 26487

K.K. Ashisuto
Daini-Suzumaru Bldg., 6th Floor
8-1, Nishi Shimbashi
3-Chome Minato-ku
Tokyo, 105, Japan
(03) 437-0654
Telex 781 26196

Singapore
Cyberware Consultants (PTE) Ltd.
2902 Pangkor
Ardmore Park
Singapore 1025
734-8142

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Planning Services For Management

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ABSTRACT

The breakup of AT&T and the deregulation of the telecommunications industry has created user confusion over the course of action to take in optimizing the corporate voice/data network. This report describes current and future LAN and CBX product trends and presents an extensive planning process for managers. The process describes the steps required to ensure successful implementation of a LAN or CBX strategy that will meet corporate needs for integrated voice/data networks.

This report contains 151 pages, including 28 exhibits.

LAN/CBX TRENDS:
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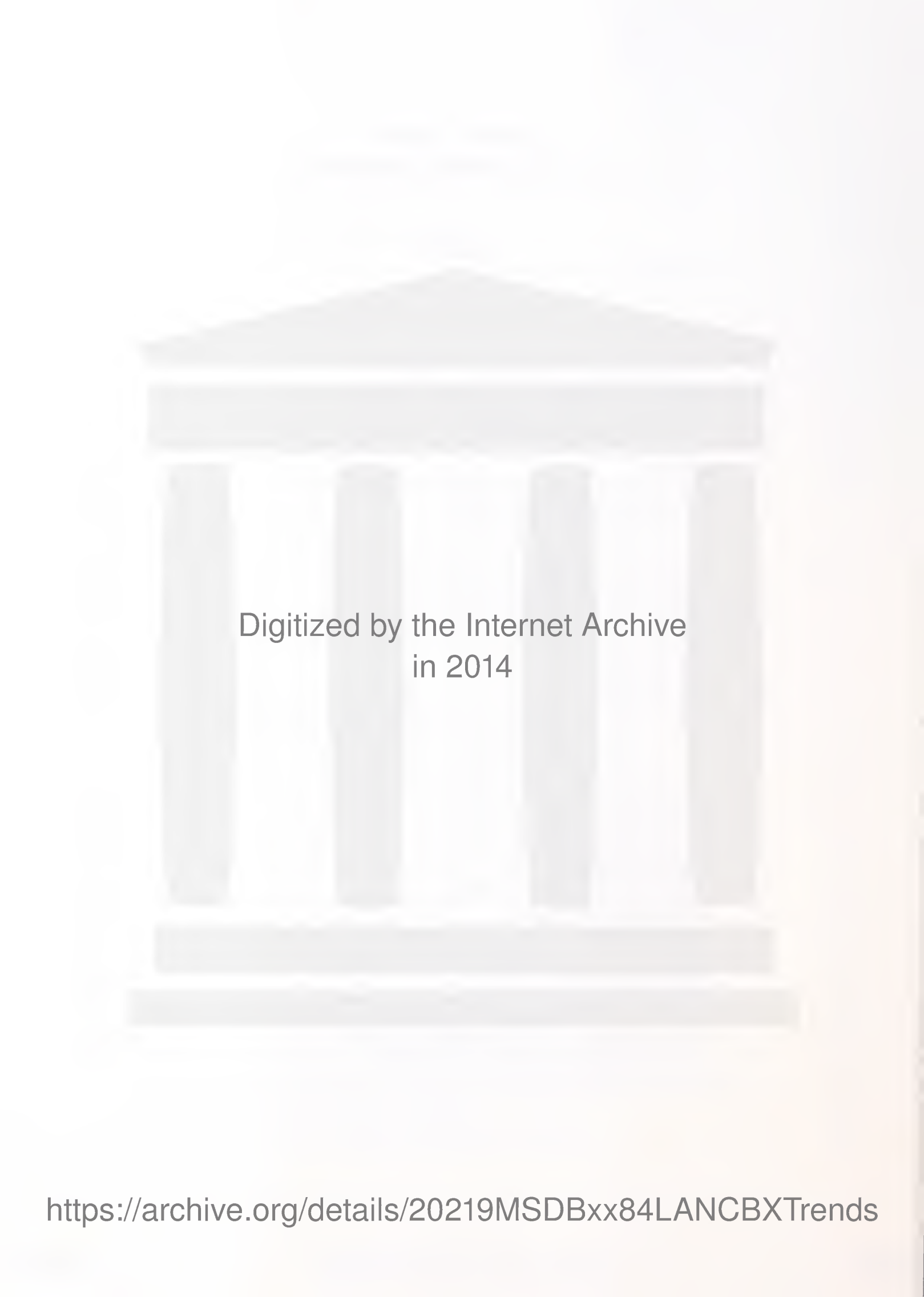


1 INTRODUCTION

I INTRODUCTION

A. RATIONALE

- Local area networks (LANs) and computerized branch exchanges (CBXs, the so-called "fourth-generation PBX") are relatively new, somewhat competitive, and overlapping technologies. They offer the benefits of digital, integrated voice and data linkages. They are the connection between telecommunications and office automation applications.

  - If correctly introduced, LANs and CBXs can increase productivity and prepare the corporation for future growth.

  - If LAN/CBX strategy is not properly planned, an inappropriate system may be selected at an unnecessary expense.

- LANs and CBXs are in a period of change, which makes this report particularly relevant.

  - The announcement of a cabling standard--but not a LAN--by IBM may have delayed the establishment of a de facto standard, but it has also opened the door for other vendors to meet current needs in the absence of a fully developed IBM product.

- The entry of AT&T into the computer business, its announcement of a LAN, and its continuing market presence with PBXs/CBXs creates dynamics affecting the IS/telecommunications decision process.

- Corporate alliances such as IBM/Rolm, Wang/Intecom, and others are leading to the introduction and promotion of products fitting various user installation requirements.

- Start-up companies have introduced numerous systems fitting a variety of niches and vertical industries. In preparing this study, INPUT identified more than 75 suppliers and 45 PBX/CBX suppliers.

- There are also data-only PBXs offerings other choices.

- There is concern that a selected system may not grow with user needs, or that newer products may eventually replace today's state-of-the-art technology.

- As a result, there is user confusion over which type of system to choose, if any.

- An INPUT survey of IS managers indicates that a methodological approach is needed to evaluate these technologies and the individual products offered by leading vendors.

- An industry survey found that 40% of respondents plan to install new, additional, or replacement PBX equipment within the next year.

  - Ninety percent of those said they will select a digital CBX.

  - Seventy percent plan to integrate voice and data.

- More than half will use the new equipment as a LAN or will connect it to a LAN.

- This report is designed to be a manual for the planning, selection, and operational implementation of LANs and CBXs. A key feature is a definitive approach to the planning process.

  - By using or adapting the guidelines presented here, users can save considerable current and future costs associated with the LAN/CBX decision process.

  - Further, the guidelines will help strengthen any management presentation and will work to provide greater certainty in decision making.

B. PURPOSE

- The purpose of this report is to provide a comprehensive framework for strategic decision making in implementing office-of-the-future networking technologies.

- This report assumes the reader is technically knowledgeable of the principles of telecommunications and data communications.

- The report is intended to provide a systems approach to determine the best structure for the corporate "nervous system."

- By using the recommended approach, professionals responsible for the corporate network and telecommunications services will be:

  - Better prepared to analyze the corporation's present and future needs.

- Better prepared to present, justify, and advocate capital-intensive solutions to problems.

C. SCOPE AND METHODOLOGY

- This report is part of INPUT's Information Systems Telecommunications Program. The study is directed to the information systems (IS) manager, the telecommunications manager, and in some cases, the office manager. It addresses the following issues:

  - The opportunities and risks for users as a result of the deregulation of customer premises equipment (Chapter III).

  - LAN/CBX product descriptions and future trends analysis (Chapter IV, Appendix B, and Appendix C).

  - The user's planning processes and selection criteria (Chapter V).

  - Current and future acquisition and operational cost analysis (Chapter VI).

- The information for this report was gathered from the following sources:

  - Structured interviews with personnel from 20 companies using or planning to install a LAN or a CBX.

  - In-depth interviews with leading LAN/CBX vendors.

  - INPUT's studies on executive workstations and micro-to-mainframe communications.

- An analysis of vendor-supplied product literature and a review of secondary research.

- INPUT has taken the best planning processes and subjected them to further analysis to serve as the basis for synthesized optimal approach recommendations to the LAN/CBX purchase and implementation decision.

D. OTHER RELATED INPUT REPORTS

- Interested readers are referred to the following INPUT reports:

  - End-User Micro-Mainframe Needs.

    . Concentrates on the experiences of organizations that use PC-to-mainframe systems. It also identifies systems requirements and projects future effects.

  - Micro-Mainframe: Telecommunications.

    . Analyzes, in detail, personal computer communications modes, their advantages and limitations, and how these communications are likely to change in the next two to three years.

  - Local Area Networks: Directions and Opportunities.

    . Focuses on the realities of LAN technology and implementation. Actual experience is emphasized and vendor claims are critiqued.

II EXECUTIVE SUMMARY

II EXECUTIVE SUMMARY

- This Executive Summary is designed in presentation format to help the busy reader quickly review key research findings and recommendations. It will also provide an executive presentation, complete with script, to facilitate group communications.

- The key points of the entire report are summarized in Exhibits II-1 through II-8. On the left-hand page facing each exhibit is a script explaining that exhibit's contents.

A. A METHODOLOGICAL APPROACH IS REQUIRED

- Each corporation has its own unique set of circumstances and needs that must be factored in the decision matrix.

- Every alternative should be considered including integration of voice, data, and office systems. The current alternatives to accomplish this integration include:

  - Upgrading current PBX.

  - Installing third-generation CBX.

  - LAN.

  - Integrating fourth-generation CBX (voice and data) with LAN.

- The planning horizons for the corporate network should be increased to a five- to seven-year period, and the telecommunications plan should dovetail with the overall corporate business plan.

EXHIBIT II-1

A METHODOLOGICAL APPROACH IS REQUIRED

Solve Network Problems

=

Considering Unique Needs

+

An Evaluation of All Choices

+

A Five-to-Seven-Year Planning Horizon Tied to the Corporate Plan

B. USERS ARE CONFUSED

- INPUT's survey of user attitudes and current planning processes has found considerable confusion among telecommunications professionals caused by a number of factors:

  - The deregulation of the telecommunications industry.

  - The breakup of American Telephone and Telegraph (AT&T).

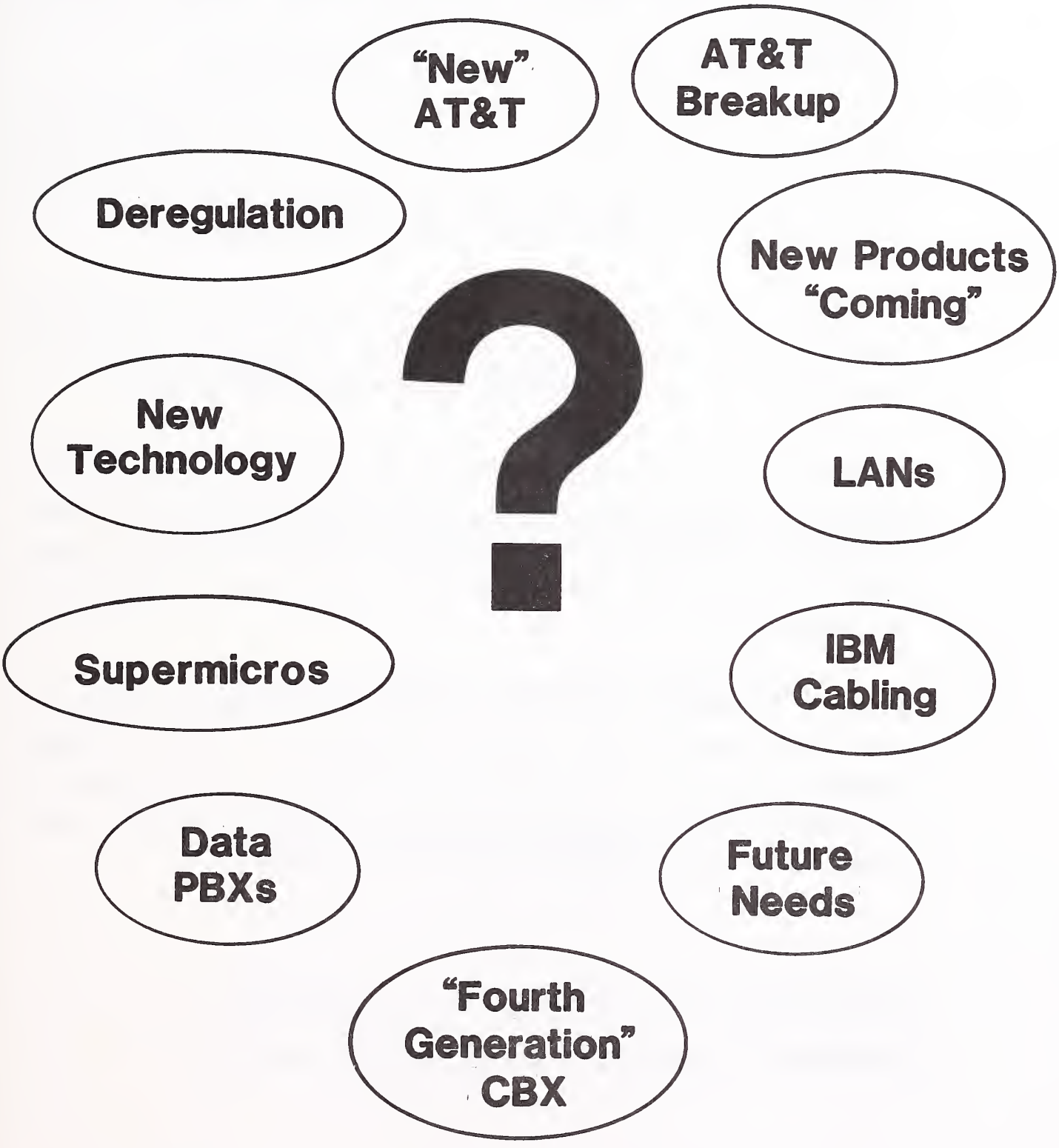
  - The increasing number of choices created by the new competitive environment.

  - The increasing number of choices created by new technologies and new product features.

- This overload of products and the rapid changes in the telecommunication environment must be addressed. The users' demand for information from multiple locations is forcing management to develop cogent telecommunications networks. The volatility of the pricing of communications products and services further adds to the complexity. The growing importance of telecommunications to the success of corporations heightens the need for IS's disspelling this confusion and developing a realistic telecommunications plan.

EXHIBIT II-2

USERS ARE CONFUSED



C. I.S. IS USING AN INTUITIVE APPROACH TO PLANNING

- IS is taking an informed but often intuitive approach to network-planning projects. A typical user explanation of the planning process is "Well, we get together in the group, talk about the problem, then go with the vendor we know the best."

- There is increasing reliance on vendor information. Vendors provide network design and other value-added services that users often have neither the skills nor the time to approach. This reliance is potentially dangerous, since sales representatives or systems integrators cannot always be objective.

- IS is experiencing accountability requirements on all systems. The corporate network was formerly considered a necessary expense. The view is now emerging that it is an asset, contributing to the bottom line (profits).

- Requirements for higher speed, greater bandwidth, and greater capacity in telecommunications services are increasing particularly in the large corporations. There are tendencies toward department mergers or high-level cooperation between the telecommunications, data processing, and information services managers.

- Tension is increasing among users as cycles of technological advancement feed fears of technical and managerial obsolescence. Telecommunications managers, however, are often isolated from the overall strategic plan of the corporation. Thus the importance of telecommunications is not being effectively addressed at the corporate level.

EXHIBIT II-3

I.S. IS USING AN INTUITIVE APPROACH TO PLANNING

- Reliance on Vendors
- More Accountability
- Greater Capacity/Capability Needed
- Cooperation: DP/IS/Telecom
- Fear of Obsolescence
- Isolation of Telecom /IS Managers from Corporate Strategic Planning

D. THE INFORMATION AGE IS HERE

- There are literally daily advances in office automation and telecommunications technology designed to meet both broadly defined and niche-specific needs. Vendors have created a very complex and dynamic competitive environment.

  - Preannouncing products preempts other vendors' sales.

  - The formation of alliances and joint ventures ensure market leader equipment compatibility in a strategy designed to "capture" installed equipment locations for advanced networking products.

- INPUT's analysis of the telecommunications industry confirms:

  - Increasing sales of communicating office automation equipment.

  - The proliferation of standalone systems in the office.

  - That workers will spend more time creating, managing, manipulating, and storing data of all forms--a sign of "the information society."

  - More links between microcomputers and mainframes.

  - A corporate desire to remain competitive through use of office automation productivity tools.

  - Recognition of integrated voice and data systems benefits, linking different types of equipment despite technical incompatibility.

- INPUT's industry analysis also finds a growing requirement for telecommunications professionals with both technical knowledge and business skills.

EXHIBIT II-4

THE INFORMATION AGE IS HERE

- Daily Technological Advances
- Complex, Dynamic Competition
- Tactic of Preannounced Products
- Alliances and Joint Ventures: IBM/Rolm, Wang/Intecom, Others
- More Communicating Equipment
- More Standalone Systems
- More Micro-to-Mainframe Linking
- Concern for Integration - Voice/Data, Various Equipment
- Competitive Drive through Technology Usage
- A Continuing Need for Qualified Professionals

E. THERE ARE FOUR ALTERNATIVES FOR INTEGRATING VOICE AND DATA

- Once a decision has been made to implement an integrated telecommunications, office automation, and data communications network, a number of alternatives must be evaluated.

- The technologies that offer solutions are:

  - Adding integrated data switching to voice PBXs.

  - Third-generation voice and data CBX.

  - Local area network.

  - Fourth-generation voice and data CBX with integrated LAN.

- Within each possible solution are decision issues requiring deliberation and analysis.

- LANs generally fulfill needs for high-speed, high-capacity situations (along with other factors). The advent of the fourth-generation CBX offers an integrated voice/data switching mechanism that is flexible in usage and expandability and can use existing wire to link office automation equipment (PCs, terminals, printers, plotters, facsimiles, modems, and voice instruments). The emerging PNX concept integrates the best features of LAN and CBX at the lowest internal system level. It offers more efficient voice and data handling than any other solution.

EXHIBIT II-5

THERE ARE FOUR ALTERNATIVES FOR INTEGRATING VOICE AND DATA

- Upgraded PBX
- Third-Generation CBX
- LAN
- Fourth-Generation CBX with Integrated LAN, Including the PNX Concept

F. RISKS: MORE CHOICES MEAN MORE CHANCE OF ERROR

- Major risks for users in the newly deregulated marketplace center on the cessation of "one-stop shopping" for telecommunications equipment and services. Because of the new competitive environment, there are more choices and therefore more chances for error.

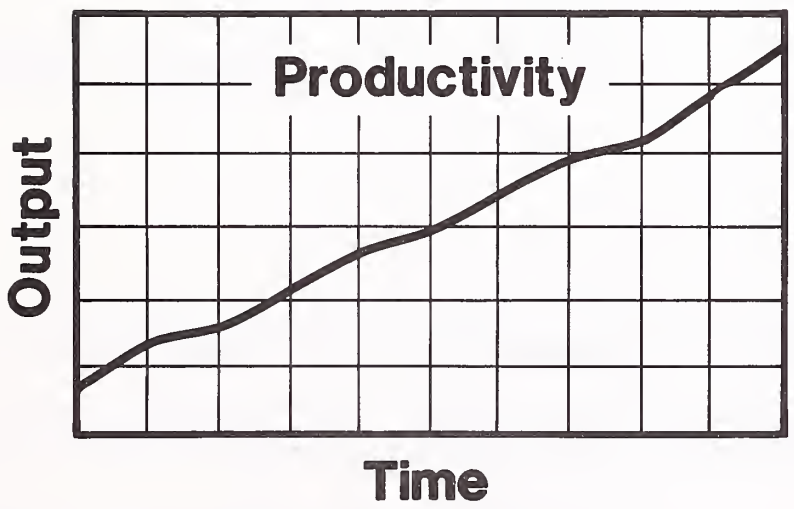
- The major benefit of the newly deregulated telecommunications environment centers on the adoption and use of productivity-enhancing technology. Special needs are being met by products fitting specific niches. A unique problem may now be solved.

EXHIBIT II-6

RISKS

More Choices Mean
More Chance of Error

BENEFITS



G. PLANNING IS THE KEY TO SUCCESS

- A planning process is needed because of expense involved and because of the confusion caused by the new competitive environment and new, unfamiliar technologies available.

- The planning process should involve key departments, ideally represented on a task force, allowing optimum participation and enhancing the quality of decision making. Some situations may require a consultant for added technical expertise and conflict resolution.

- Proper planning helps the manager to make decisions. Planning provides the factual background for making recommendations to upper-level management and ensures confidence in supporting and defending those recommendations.

EXHIBIT II-7

PLANNING IS THE KEY TO SUCCESS

- **Because of Complexity**
- **Because of Expense**
- **Because Participation Equals Better Decision Making, Acceptance**
- **Because Telecom/IS Managers Need to be Convinced in Order to be Convincing in Their Recommendations**

H. PLANNING IS MULTIFACETED

- The key steps in the planning process are:
  - Involve staff and keep management informed.
  - Review the status quo: cost, methods, patterns, equipment.
  - Review company growth projections.
  - Assess needs: equipment replacement, user and manager surveys, special requirements review.
  - Link telecommunications/office automation planning to the overall corporate strategic plan.
  - Analyze corporate financial considerations: availability of necessary funds.
  - Analyze relevant aspects of corporate culture: acceptance or animosity toward changes in the telecommunications/office automation structure.
  - Evaluate: vendor information, trade shows, peer groups, on-site review, features.
- These steps will lead to a preliminary decision on the type of technology suitable for the situation. Then attention can be focused on matching needs with capabilities, features, and functions of specific products.

EXHIBIT II-8

PLANNING IS MULTIFACETED

- Status Quo Review
- Needs Assessment
- Corporate Culture Factoring
- Evaluation of Equipment/Solutions
- Proposal/Vendor Evaluation
- Financial Analysis
- Implementation

III OPPORTUNITIES AND RISKS FOR USERS AS A RESULT OF DEREGULATION OF CUSTOMER PREMISES EQUIPMENT

III OPPORTUNITIES AND RISKS FOR USERS AS A RESULT OF DEREGULATION OF CUSTOMER PREMISES EQUIPMENT

A. SALIENT ASPECTS OF THE DEREGULATION OF CUSTOMER SERVICE EQUIPMENT

- Events leading to the deregulation of the telecommunications industry span several decades. These events are outlined in Exhibit III-1. Court rulings of the past several years have created a new environment in the industry, one that places new burdens on the user.

1. DIVESTITURE AND DEREGULATION

- The information services or telecommunications manager is familiar with the divestiture of the Bell System and the deregulation of the communications industry. In order to provide a historical perspective on how these events affect the implementation of a LAN/CBX strategy in the corporate environment, a brief summary and a few definitions are appropriate.

  - Customer premises equipment (CPE) - Equipment used on the premises of a person to originate, route, or terminate telecommunications, not including equipment used to multiplex, maintain, or terminate access lines. This equipment either is leased from the telephone company or is owned by the user. It includes telephones, private branch exchanges, automatic recording sets, dialers, and speaker phones. Pursuant to the

EXHIBIT III-1

DEREGULATION OF CPE

- Before 1968 AT&T and Telecos Operated as Monopolies.
- In 1968, FCC's Carterphone Decision Opened Telecommunications Competition.
- In 1980, FCC's Computer Inquiry II Decision
  - Deregulated Telephone Terminal Equipment.
  - Allowed Communications Companies to Sell Data Processing Services.
- On January 1, 1984, AT&T Divested 22 BOCs.
  - CPE Transferred from BOCs to AT&T.
  - Inside Wiring Has Stayed with BOCs.
  - BOCs Can Sell, Not Make, Equipment.
  - BOCs Cannot Discriminate in Product and Service Purchases.

FCC decision, all new CPE installed since January 1, 1983 is deregulated. Under the divestiture, all CPE provided by the Bell operating companies (BOCs) was transferred to AT&T early in 1984. Discussion and dispute over what is or is not CPE continues.

- Deregulation - The removal of government controls, allowing the free market to determine the availability and cost of services.

- Flagship equipment - The newest, top-of-the-line offerings, representing the most advanced state of the art.

- Modified final judgement - The divestiture agreement between the Department of Justice and AT&T. It is the basis for settling the 1974 antitrust suit against AT&T.

2. MILESTONES TOWARD DEREGULATION

a. Before 1968

- The Bell System and the independent telephone companies operated as complete monopolies, providing equipment and local and nationwide service.

- Western Electric and Bell Labs were a major influence in the development of product standards.

- AT&T used its position as parent company of the operating companies to prevent the purchase of products competitive with Western Electric. The operating companies were essentially deprived of independent procurement functions.

- In some cases AT&T and Western Electric withheld technical information from other manufacturers, preventing competitors from selling to the Bell operating companies.

- Due to its role as exclusive supplier to the local Bell operating companies, Western Electric was virtually the only manufacturer and provider of customer premises equipment.

- This supply relationship was reinforced by "foreign attachment" tariffs which generally prohibited attaching any terminal equipment not supplied by a Bell operating company to telephone company lines or equipment.

b. In 1968

- The FCC concluded that foreign attachment tariffs were unreasonable, discriminatory, and unlawful. It issued the Carterphone decision, allowing customer-owned telephone terminal equipment to be connected to the phone system. This was the start of modern telecommunications competition.

- Responding to Carterphone, AT&T filed revised tariffs with the FCC requiring that connections of any customer-provided terminal equipment to the network be accomplished through a protective connecting arrangement (PCA) provided, installed, and maintained by the BOCs.

- The United States Department of Justice claimed that the PCA was an unreasonable restrictive barrier, unnecessarily impeding competition in the market, and noted there are alternatives to providing protection of the public-switched telephone network.

c. In 1973

- The FCC's Computer Inquiry I ruled that data processing equipment and services are not subject to its regulation, and that communications companies such as AT&T cannot provide DP services.

d. 1975 and 1978

- The FCC adopted a registration/certification program for customer- and carrier-provided terminal equipment, aiding the establishment of standards and the development of competitive products.

e. 1978

- Companies such as Microwave Communications Inc. (MCI) were able to provide message toll service competing with the Bell and the independent systems.

f. 1980

- The FCC's Computer Inquiry II decision ordered deregulation of telephone terminal equipment. AT&T was ordered to form a subsidiary to handle deregulated activities, now separated from other services. It also allowed the company to provide data processing services.

g. On January 1, 1984

- In an antitrust settlement and under a widely-reported consent decree, AT&T, the world's largest corporation, dismantled itself, spinning off its 22 wholly owned BOCs. The divestiture plan has incorporated earlier rulings. The following provisions have a definite impact on CPE:

  - CPE ownership is transferred from the BOCs to AT&T.

  - However, station connections and inside wiring are not considered CPE and therefore remain with the BOCs.

  - The BOCs can sell but cannot manufacture CPE; they can conduct business anywhere (in other words, they are not limited to their regions).

- The BOCs are prohibited from discriminating between AT&T and its affiliates, and other suppliers in the procurement of products and services.

3. AT&T'S MIGRATION STRATEGY

- Prior to the 1980 deregulation of CPE, AT&T initiated a "migration strategy" intended to move present customers to flagship products by upwardly pricing tariffs on older equipment in relation to newer equipment.

- Some telecommunications users objected to this tactic saying it promoted wasteful churn and abandonment of useful assets.

- Further, because BOC accounting procedures deal with the undepreciated portion of a retired piece of equipment, users essentially paid for retired equipment through other equipment or service charges. In states approving migration tariffs, 90% of the older equipment was retired. This created opportunities for users to consider equipment from any vendor to serve long-term needs.

B. OPPORTUNITIES FOR USERS IN A DEREGULATED CPE MARKETPLACE

- The change in the status quo has created some beneficial circumstances for users, as shown in Exhibit III-2.

- Users have more equipment choices to solve particular communications and office automation problems.

- Greater economies can be realized by the installation of flagship equipment, which extends the useful life of existing equipment.

EXHIBIT III-2

OPPORTUNITIES IN CPE DEREGULATION

- More Equipment Choices
- Flagship Equipment Can Extend Life of Existing Equipment
- Technological Advances Encouraged
- Competitive Pricing

- The competitive marketplace encourages technological advancement to meet current and future needs.

- Equipment can be configured to fit particular requirements, regardless of supplier (assuming compatibility).

- The competitive environment forces competitive pricing, resulting in cost savings for users.

- Installed wiring may be purchased from the BOCs and used for local area networks, saving on new wiring installation.

C. RISKS FOR USERS IN A DEREGULATED CPE MARKETPLACE

- With changes in the telecommunications environment, significant pitfalls await the unwary and the uniformed, as shown in Exhibit III-3.

- Equipment, once coming from essentially one source, is now available from many. The procurement process becomes costlier, more complex, and more time consuming.

- Service and maintenance, once supplied by one source, is now available from many sources. If equipment failures are not properly traced, the wrong vendor may be contacted for costly service calls.

- In-house maintenance and installation requires more highly qualified personnel and staffing increases.

- Users may find unproven vendors going out of business, leaving service and parts availability in question.

EXHIBIT III-3

RISKS IN CPE DEREGULATION

- Procurement Process More Complex, Costlier
- Service and Maintenance More Diffused
- Need for Costlier, Qualified Personnel
- Failed Vendors Create Service and Parts Availability Problems
- Patchwork Solutions Not Necessarily Best
- Standards and Compatibility Problems
- Sales Pressures Can Confuse Decision Making
- "Market Overhang" - Announced Products Not Yet Available
- Tendency to Purchase New Equipment When Old Equipment is Functional
- Future Needs and Technical Advances May Not Be Met By New Equipment
- Unproven Technologies Can Lead to Expensive Mistakes

- Patchwork solutions may prove undesirable long range.

- Because of the availability of diverse equipment, standards and compatibility become more of an issue.

- The competitive marketplace features pressures from vendors, which can confuse users and cloud the decision-making process. Vendors' help is not necessarily objective.

- The competitive environment encourages the announcement of new products not yet available ("market overhang"), which can cause users to "do nothing" until standards are established. This tends to protract the use of obsolete equipment.

  - Because of new product introductions, companies may be inclined to replace substantial amounts of useful and functional equipment, contrary to business interests. Unnecessary capital investments may do nothing to improve corporate productivity.

  - Users must anticipate future needs. Will future needs be met by new equipment? Will integrated systems be able to accommodate technological advances in data/voice communications?

  - Installation of unproven technologies can lead to expensive, career-shattering mistakes. The burden of success is more dependent on uses. In-house diligence becomes more significant.

D. BENEFITS OF A LAN/CBX STRATEGY

- Productivity-enhancing tools such as electronic mail, computer conferencing, company-wide scheduling, and on-line data base retrieval can be implemented.

- Expensive equipment such as workstations, word processors, printers, facsimile machines, and modems can be shared among work groups, requiring lower capital expenditures.

- Communications among work groups located in diverse plant locations and remote locations is improved, enhancing the decision-making process.

- The workplace environment will be improved.

- A LAN/CBX strategy prepares the company for the benefits of the developing Integrated Services Digital Network (ISDN) and the cost savings of new technologies such as teletex, which will eventually replace Telex.

E. RISKS OF IMPLEMENTING A LAN/CBX STRATEGY

- If improperly installed, equipment failures can shut down corporate operations.

- Jurisdictional disputes between the data processing and telecommunications departments can create uncomfortable work environments.

- More cost-effective equipment may be introduced "shortly," making today's purchases obsolete.

- Advanced features may not be used, meaning that unproductive investments will have been made.

- The relative benefits and risks of a LAN/CBX strategy are charted in Exhibit III-4.

F. HISTORY AND DEVELOPMENT OF THE FOURTH-GENERATION CBX

- The first generation includes electromechanical step-by-step and crossbar switches.

- The second generation features a central processing unit controlling the system through stored program logic.

- The third generation handles both voice and non-voice signals over twisted pair circuits, using inexpensive microprocessors and distributed architecture.

- The fourth generation integrates a LAN. It is specifically designed to integrate voice and data, whereas earlier PBXs added data-handling ability as an afterthought.

- The identity of the first fourth-generation switch is a matter still in dispute. Some say it was the Datapoint 1981 ISX; however, United Telecom claims its UTX 1001, also introduced in 1981, was first.

- The label "fourth generation" might be considered marketing hype, since manufacturers seek to differentiate their products. However, there are some distinct differences in the technology.

EXHIBIT III-4

BENEFITS OF LAN/CBX STRATEGY

- Productivity Enhancements
- Decision-Making Enhancement
- Workplace Environment Enhancement
- Movement toward ISDN and New Digital Technologies

RISKS OF LAN/CBX STRATEGY

- Equipment Failures Can Halt Operations
- Jurisdictional Disputes between DP/IS/Telecom
- New, Possibly Better Equipment Coming "Shortly"
- Unused, Unneeded Features Mean Bad Investment

1. ABOUT THE CBX ("FOURTH-GENERATION PBX")

- Early generations of PBXs were designed primarily for voice switching. Data-switching capabilities were added in the third generation. The so-called "fourth generation" is designed specifically for integrated communications, as the central controller for the office of the future.

- All use twisted pair circuits as the primary transmission media. This offers economical access in existing buildings.

- Generically, all manufacturers tend to design their products to be flexible and adaptable to various customer needs. Expandability and functionality of CBXs are features of this product planning.

- Because of modular growth capability, CBXs are designed to be useful for an extended period.

2. CBX GENERIC PRODUCT FEATURES

- Universally, CBXs have common characteristics. These are summarized in Exhibit III-5.

- Voice and data are fully integrated. Transmission is on the same twisted pair. Ideally, the same ports are used for both voice and data.

- Integrated LAN functions include:

  - High speed.

  - Enough bandwidth for present and future office automation applications.

EXHIBIT III-5

CBX FEATURES

- Full Voice/Data Integration
- Integrated LAN
- Distributed Architecture
- Digital Instruments (CODECs)
- Dual Bus Architecture: Packet Data and PCM Voice
- Non-Blocking
- True Costs Lower Due to Function Integration

- The possible eventual inclusion of switched full-motion video capabilities.

- Distributed intelligent architecture means that:

  - Each module or node can be considered an independent CBX that supports a number of stations, instruments, or data extensions.

  - Many "switches" act in concert, each with processing ability, and are not controlled by a central unit.

  - A redundancy feature ensures that integrated diagnostics and monitoring systems will automatically reset to back up cards in case of failure.

  - Each node has a data base of features and user addresses.

  - New stations can be installed simply, and the system can grow easily since there is no upper CPU limit. Capacity and enhancements can be added incrementally, and each module adds intelligence.

- CBX features digital instruments. Integrated Pulse Code Modulation (PCM) CODECs (coder/decoders) convert voice to digital signals.

- The product provides RS 232-C ports for PCs and terminals.

- Advanced features include:

  - On-board display screen.

  - On-line directory.

  - Integrated electronic mail systems, including voice mail.

  - Programmable soft keys on instruments.

- Telemanagement features applied to the data network allows:
  - Service restriction.
  - Detailed call accounting.
  - Least-cost routing.
- The dual bus switching architecture provides:
  - The PCM for voice.
  - A packet for bursty data traffic.
  - Packet switching, averting the need for a special gateway to digital common carriers.
- The CBX features nonblocking. This means that, although data transmission requires more time than voice, the system is designed to handle increased traffic.
- Layered software architecture is standardized and structured like a computer's, based on the International Standards Organization's reference model for open systems interconnection.
- Ideally, the product will include format, protocol conversion, 3270 terminal emulation capability, and direct T-1/T-2 carrier connection to the central office. Synchronization is maintained on both ends of the connection.
- Cost factors: Because of modularity, additional line costs are nearly constant and independent of system size and features. Since functions can include integrated automated building management, security, utilities, and energy controls, as well as data and voice communications, true costs are lower than those for other configurations or standalone systems serving these needs.

G. LAN GENERIC PRODUCT FEATURES

- The characteristics that are common among LANs are outlined in Exhibit III-6.

- A local area network:

  - Is company owned and is not subject to FCC or other government regulations.

  - Integrates various equipment and applications on the networks, including data processing, electronic messaging, images, and voice.

  - Supports full connectivity. Ideally, every device can communicate with every other device.

  - May bridge to other similar LANs or may have gateways to dissimilar networks.

  - Runs at high speed; LAN speeds range from 500 Kbps to over one billion bps (on fiber optics).

- LANs are generally installed in situations requiring large bandwidth and supporting heavy traffic between and among workstations, peripherals, and central computers.

- LANs were developed in data processing industry. Their use eliminates the need for a standalone data network by integrating data communications links with functional access to a wide variety of peripherals, controlled by the network's designed intelligence.

EXHIBIT III-6

LAN FEATURES

- Corporate Ownership, Unregulated
- Integrates, Connects All Equipment/Applications
- Bridges/Gateways to Other Networks
- High Speed/Wide Bandwidth

H. RELEVANCE OF CURRENT AND FUTURE ECONOMICS

- Current and future economics are the most difficult elements to determine in the LAN/CBX design process.

- Not only are these elements significant (by their very nature), but they also constitute an area where major mistakes are made with short-term cost savings and long-term cost efficiency.

- Comparisons are difficult. In many cases, it is not only a matter of comparing dissimilar products, but because costs continue to decline rapidly as the market develops, the cost-comparison factor further complicates product comparisons.

- In judging price, INPUT has found that many of the "rules of thumb" applying to long-haul networks and data processing technologies remain generally applicable to LAN/CBX networks.

  - Older, established technologies are less expensive than state-of-the-art and experimental technologies, primarily because of economies of scale in the vendor learning curve and in the manufacturing process.

  - Similarly, "off-the-shelf" hardware is much less expensive than custom systems.

  - Proportional increases in prices are higher than the concomitant increases in the development of network services.

  - Proportional increases in prices are higher than the concomitant increases in the levels of speed and performance.

- Seemingly lower acquisition costs tend to be offset by hidden, higher variable operational costs for:

  . Maintenance/repairs.

  . Diagnostics/testing.

  . Control and administration.

  . Moves and changes.

- A true measure of system cost is a "life cycle cost" rather than the "initial acquisition cost." A fixed acquisition cost system invariably leads to conflict with the vendors in attempts to modify the system or include very small additional features.

- A frequently used leveler is the average-price-per-workstation connection in the case of LANs and the average price per line in the case of CBXs.

  - However, the average price may vary widely depending on what is included.

  - In many cases, the prices of features and services often exceed the price of basic hardware/software.

- When vendors were asked to approximate the price per connection of their LAN, the prices quoted ranged from $200 to over $40,000. The quote depended on whether the price was simply the cost of connecting a user station to a preexisting LAN or whether the total cost of the whole network system, including cabling transmission components, network management hardware and software, connection hardware, installation, and technical support, was averaged over a typical number of workstations.

- Similarly, in the case of CBXs, prices range from $500 to $1,000 per line, depending on the features required in some or all instruments, or in the central CPU to support those features.

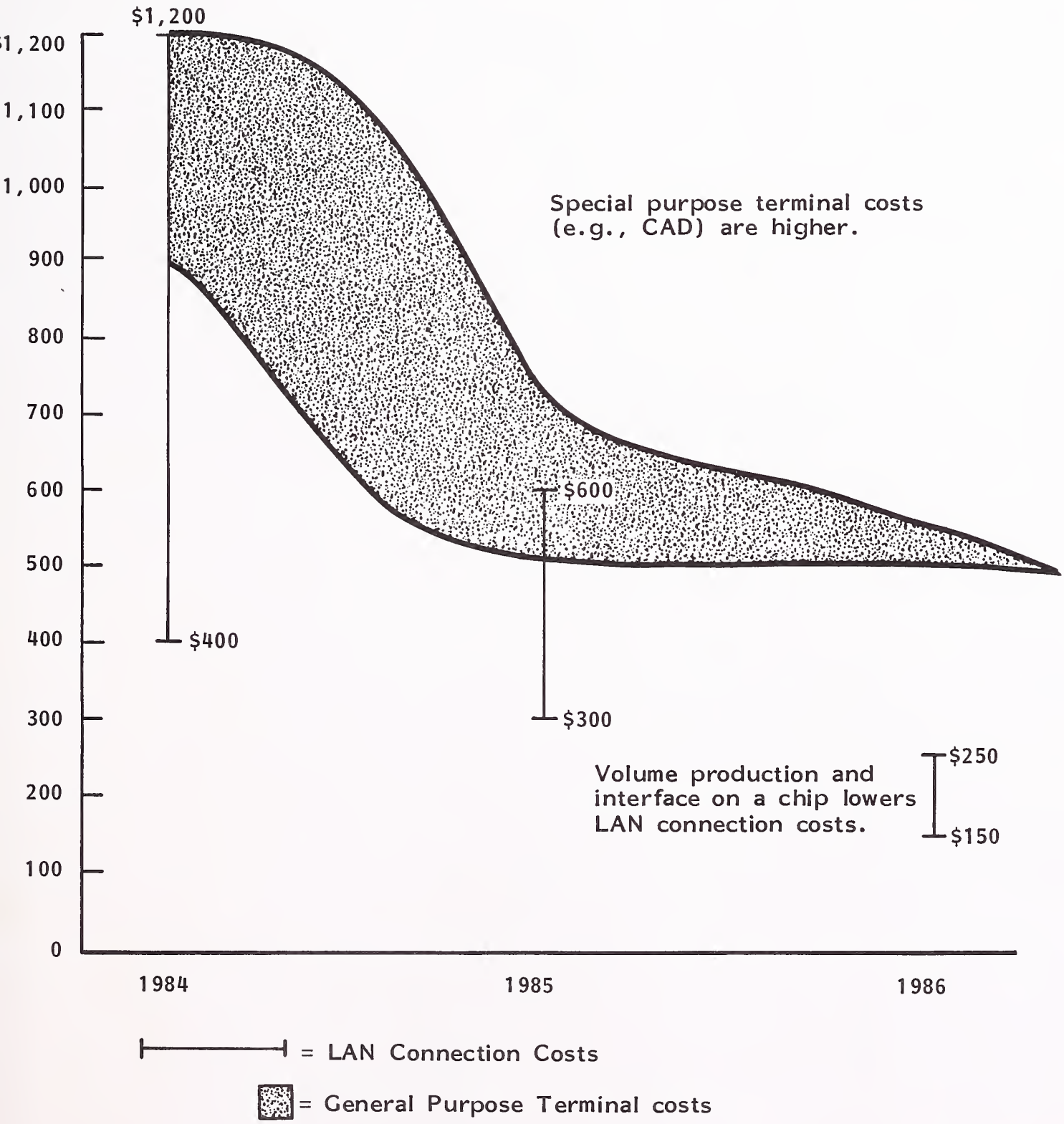
- INPUT recommends that when requesting preliminary price estimates from several vendors, users should describe a configuration that approximates needs and should attempt to specify which components are included in the price. This method would provide some ground for comparisons.

- Future needs are equally important. Currently, the typical price ($400-1,000) of connecting a user terminal into a LAN may be more than the cost of the terminal itself (or at least a significant percentage). However, as with other new technologies, prices are dropping as the number of users increases and as volume production methods are implemented.

- When LAN standards are accepted and the interface on a chip becomes available, the connection prices are expected to gradually become negligible. INPUT expects the average connection price to decline to the range of $150-250 by 1986, as shown compared to terminal costs in Exhibit III-7.

EXHIBIT III-7

LAN PRICE FOR CONNECTION TRENDS COMPARED TO TERMINAL COSTS



IV LAN/CBX CURRENT PRODUCTS AND FUTURE TRENDS

IV LAN/CBX CURRENT PRODUCTS AND FUTURE TRENDS

A. NEW COMPETITIVE ENVIRONMENT

- The deregulation of AT&T and the settlement of antitrust matters with IBM has launched a new era of competition in the communications and computer sectors of the U.S. economy.

- Most computer companies are in the process of establishing communications products and services to satisfy the integrated systems needs of their customers for both data processing and communications. For example, IBM now has communications capabilities for the following hierarchy:

  - Intrabuilding communications (Xerox and IBM/Rolm).

  - Interbuilding communications (Satellite Business Systems/IBM).

  - Intracity communications (SBS/IBM).

  - Intercity nationwide communications (CBS/IBM).

  - International communications (CBS/IBM).

- Similarly, most communications companies are establishing partnerships to provide computer-related products and services to their customers to satisfy

integrated requirements. Examples of this are AT&T/Convergent and Intecom/Wang.

- The above developments form the crux of new competitive developments growing from considerable U.S. government initiation, in transmission facilities allocation and deregulatory actions.

- The next few years will also present a "battle of the giants" as AT&T and IBM offer competitive computing and networking products. AT&T is overcoming its pre-divestiture marketing myopia with a new aggressive approach. (For example, AT&T Chairman Charles L. Brown has been making sales calls to close key accounts.) IBM will draw on both its record as a de factor standard setter, and its new strengths in the communications market through its equity position in Rolm, which essentially represents IBM in the interim strategy.

- The integration of communications and computers, and a realization by most users that productivity increases are key factors for successful competition in the domestic and international markets, reinforces the drive for complete, integrated system solutions.

- In addition, the deregulatory actions described in Chapter III have driven a new competitive era in CPE. CPE deregulation is central to new developments in CBX and telephone set technology. It is of major significance that divestiture has allowed the opening of existing markets for foreign as well as domestic companies. In addition, it has permitted technology to further widen the boundaries of existing telecommunications markets.

- From a user perspective, the new competition places a greater emphasis on future planning. Since users are no longer limited to buying hardware and services from AT&T and the BOCs, they are by the very nature of technology forced to plan ahead in order to maximize their productivity.

- INPUT recommends that users increase their planning horizons to a minimum of five to seven years in establishing requirements for LAN/CBX systems.

B. CURRENT PRODUCTS AND USER REQUIREMENTS

- Capsule profiles of major vendors' products are contained in Appendix B (CBX products) and Appendix C (LAN products). Enhancements, new features, and interface availabilities are announced virtually every day; therefore only general descriptions are provided. Pricing changes are also frequent and vary widely according to features, sizing, and other factors.

- Criteria for selecting LANs and CBXs and for evaluating features and user requirements are discussed in Chapter V.

- The leading CBX manufacturers are AT&T, GTE, Mitel, NEC, Northern Telecom, and Rolm.

- Promising new "fourth-generation" market entries include those of CXC, Telenova, and Ztel.

- Leading LAN manufacturers are AT&T, Datapoint, Network Systems Corp., Racal-Milgo, Sytek, 3Com, Ungermann-Bass, Wang, and Xerox.

- IBM has announced a cabling system that will evolve into one or more LANs in the 1986-1987 time frame.

C. FUTURE PRODUCTS AND USER REQUIREMENTS

- Information is an invaluable resource to any firm trying to be profitable in today's highly competitive business world.

- Nevertheless, cost-conscious managers remain somewhat hesitant to make what amounts to short-term investments in today's CBX/LAN. Rapid changes in the technology seem to make products obsolete even as they are being installed.

- The two central questions of future needs are also questions about the present.

  - What information management requirements are necessities now, and what will be required in the short term to survive competitively?

  - What type of system would be the best investment now and for the future?

- Even when the best possible combination of voice and data equipment is purchased, individual components may prevent upgrading. Existing voice/data PBX products of the centralized architecture variety may not provide flexibility for today's needs and will probably not meet tomorrow's requirements.

- The need to retrieve, share, and enter data is following a growth pattern similar to telephone systems in terms of networking, features, and user requirements.

- Advances in telecommunications and computerized networking provide the means to build integrated voice and data information delivery networks, combining the features and functions of a voice-switch CBX with the strengths and economies of a packet-switched data LAN.

- This new type of network will meet all voice, data, and image information requirements, growing as the company expands, at favorable economics as overhead expenses are distributed among several functions.

- Ideally, this communications system would have an architecture that would be technology independent. Users would require only equipment additions to obtain any type of new capacity of feature. Instead of reinventing basic architectures every several years, communications equipment manufacturers would concentrate on solving user problems.

I. THE PNX CONCEPT

- INPUT believes the next generation of development will take place along the lines of Ztel's PNX system, although a new product derived from further development will perhaps be more sophisticated than Ztel's product.

- "PNX" stands for Private Network Exchange and is used in this section to describe a generic product.

- By integrating the best features of a CBX and a data LAN at the lowest internal level of a system, a PNX will be able to provide better voice handling than the traditional CBX and better data handling than a separate LAN or data switch.

- The essential conceptual elements of a PNX consist of a series of functional processors connected to a LAN in a ring architecture. Some of these act as applications processors and some serve as ring processors for network control management.

- There can be more than one LAN in a ring architecture, each connected to functional processors. Functional processors can self-configure each ring to function as complete standalone voice/data CBXs if other connections

between nodes become unavailable. The desired level of "nonblocking" is achieved by adding rings to the network.

- The network would be self-adapting based on the number of rings present. Malfunctioning rings are automatically ignored (and reported) by functional processors, and rerouted traffic is directed through other rings.

- Current LAN/CBX development is attempting to evolve an integrated LAN/CBX concept along the lines of PNX.

- The software development problems are significant, but they can be solved, as Ztel has partially demonstrated.

2. POTENTIAL GROWTH IN USER REQUIREMENTS

- INPUT believes that the following conditions and applications, in addition to general growth for data communications, would be required by 1988 in order for most user organizations to be competitive in the business world:

  - Widespread use of electronic mail and increasing data base access.

  - Increasing use of voice mail, obviating the need for "pink message slips."

  - Micro (PC) to mainframe communications for improved office/factory productivity.

  - More processing power at the user desk.

  - Reduction in general purpose office paper flow.

  - Attitude change toward video and other teleconferencing. These should be seen as part of people productivity rather than as an offset

for travel costs; computer conferencing between dissimilar systems allows users to share files, color graphics, and applications interactively.

- Shared use of work resources (printers, peripherals, applications) in office/factory environments.

- Multiple-window software, increasing system capacity requirements.

- Automatic data conversion between dissimilar systems during transmission.

- Advancing security measures and data encryption techniques, ensuring privacy, data integrity, and optimum control.

- Advancing data storage technologies through dynamic storage management. Memory is allocated according to need.

- Virtual local memory. Data files are automatically moved to their highest volume point of usage.

- Optical-disk-based archival and retrieval systems. In settings requiring moderate access to a variety of documents, such systems will emulate the paper flow through an organization.

- Advanced features will be implemented as CBX/LAN strategies are developed and as more office-of-the-future equipment is networked.

3. FUTURE MARKET AND TECHNOLOGICAL TRENDS

- The user should be aware of a number of market and technological trends in CBX/LANs that are developing parallel to user needs.

a. Market Trends

- IBM's LAN is emerging as a possible de facto standard.
- Products intended to fill the void caused by IBM's absence in the LAN marketplace are being marketed.
- The marketplace will feel the impact of an IBM/Rolm market thrust clashing with the newly configured AT&T.

b. Technological Trends

- The development of fiber optics technologies will be a cost-effective element in LAN/CBX design.
- Newly developed of "smart buildings" offer shared tenant telecommunications services.
- The development of the interface on a chip will reduce LAN/CBX connection expenses.
- Bell operating companies (and others) have introduced metropolitan area data networks and digital termination services, and they have expanded the digital data services (DDS) network.
- CATV operators have evolved the data transmission services.

4. PRODUCT DEVELOPMENT IN THE TRANSMISSION MEDIUM: BEYOND THE BUILDING

- Most current LAN architectures are generally confined to intrabuilding operations of 1,500 to 3,000 feet. CBX products are connected to public voice switched networks. Due to recent frequency resource allocations, methods of

bypassing local telephone company facilities while extending the reach of the corporate network are attracting user interest.

- Additional radio frequencies have been authorized by the FCC to allow the emergence of new interbuilding and metropolitan networks, enabling the installation of connecting LANs/CBXs without dependence on the local BOCs. These include:

  - Ten GHz digital termination service (DTS).

  - 18 GHz DTS.

  - Two GHz multipoint distribution channels offering a return channel for interactive usage.

  - The development of interactive CATV systems that would allow an interbuilding and intracity transmission medium for LANs.

  - Short-haul lightwave systems to link interbuilding networks; environmental influences can, however, affect their utility.

- Fiber optic and other microwave systems are currently begin installed by many non-BOC communications companies. These companies are willing to lease transmission capacity for interbuilding and metropolitan networks.

- Users should evaluate these alternative transmission possibilities in designing their integrated voice/data private network systems. Each alternative offers benefits, and each has features that may or may not be contradicted in particular situations.

D. PRICE/PERFORMANCE AND SERVICE ISSUES

- Decisions associated with relative aspects of performance and service are key elements in the user's planning process.

- Exhibit IV-1 briefly summarizes the relative trade-offs of these issues, which should be considered by users in establishing system requirements.

- INPUT has considered the following variables in identifying these trade offs:

  - Linear bus schematic, consisting of baseband bus, single-cable broadband bus, dual-cable broadband bus, and single-cable branching tree.

  - Ring schematic, consisting of Cambridge ring and IBM-type local loop.

  - Star schematic.

  - The following performance issues:

    - Delay.

    - Throughput.

    - Reliability.

    - Robustness.

  - The following constraints:

    - Circuit speed.

    - Distance.

EXHIBIT IV-1

LAN PERFORMANCE COMPARISONS

SCHEMATIC	PERFORMANCE	CONSTRAINTS
Linear Bus	Delay: In token bus, waiting time is a fixed function dependent on the number of nodes in a network; in contention bus networks, delay is dependent on current traffic, delay distortion is possible. Throughput: In token bus networks throughput decreases with each node added; in contention networks, throughput is best in light bursty traffic conditions, and it decreases in high volume, steady traffic environment. Reliability: Failure of one station will not affect the rest of the network; break in cable will affect part of the network. Robustness: Relationship between stations is peer to peer; network is difficult to monitor; in contention network, the difference between noise and collision is difficult to distinguish.	Circuit Speed: Can vary up to 50 M bps. Distance: Generally unlimited by topology. Max^{m} No. of Nodes: User stations may be added or deleted without reconfiguring the network; in token bus network, the addition of each node affects performance. Error Rate: Twisted Pair = High Error Rate Coaxial Cable = Low Error Rate Fiber Optic = Lowest Error Rate Cost: Generally lower cost per user than star network and higher than ring network.
Ring	Delay: Waiting time is a fixed function dependent on the number of nodes. Throughput: Decreases with each added node.	Circuit Speed: Varies up to 10 M bps. Distance: Limitations are imposed on both total distance and distance between nodes.

EXHIBIT IV-1 (Cont.)

LAN PERFORMANCE COMPARISONS

SCHEMATIC	PERFORMANCE	CONSTRAINTS
Ring (Cont.)	Reliability: If one station fails, the whole network fails unless bypass circuitry has been implemented in each node; if loop is severed, the whole network fails unless redundant features have been implemented. Potential low reliability can be compensated by better engineering design. Robustness: Nodes are easy to understand, construct, and maintain; may require custom designed; device-dependent interface; communications control overhead is very high; if network fails, recovery may be difficult and may require complex logic and processing.	Max^{m} No. of Nodes Dependent on command station capacity. Addition of each station directly affects performance. Error Rate: Twisted pair wire is vulnerable to transient errors; fiber optics has very low error rate. Cost: Lower cost per station than any other schematic.
Star	Delay: In heavy traffic, request for service may be blocked at the switch in a PBX/CBX. Throughput: Dependent on internal bus capacity of central node. Reliability: Failure of one station does not affect rest of the network. If central node fails, the whole network fails. Robustness: Ready availability of network monitoring and control software; high overhead for communications control; does well in master/slave environment and networks.	Circuit Speed: Varies considerably depending on the medium. Distance: Limitations are imposed on distance between central node and any user station. Max^{m} No. of Nodes: Dependent on the capacity of central node; difficult to reconfigure. Error Rate: Twisted pair wire is vulnerable to transient errors. Cost: High initial cost but low incremental cost.

- Maximum number of nodes.
- Error rate.
- Cost.

V PLANNING PROCESS FOR USERS AND PRIORITIES FOR DECISION CRITERIA

V PLANNING PROCESS FOR USERS AND PRIORITIES FOR DECISION CRITERIA

A. PLANNING PROCESS: SPECIAL ATTENTION OR BUSINESS AS USUAL? THE NEED FOR A FORMAL PLANNING PROCESS

- The one-stop shopping of the past is gone, along with the comfortable relationship users had with AT&T for all equipment, services, and training.
- Different vendors are providing different pieces of the communications equipment puzzle.
- Vendor help is not necessarily objective; users must be more self-sufficient.
- Because of the expense and complexity involved, a comprehensive planning process to select the right equipment configuration for present needs and future applications is required.
- The planning process must provide the telecom manager/information services director with "ammunition" to support decisions presented to corporate management.
- A task force representing involved departments is mandatory in most situations.

- The services of an experienced outside consultant is useful in situations where department needs are in conflict and when technical expertise is needed. The consultant can facilitiate conflict resolutions and can provide focus on the project.

- A well-documented, carefully prepared plan with staff and management participation can mitigate unforeseen problems for the telecom/IS manager that may arise after implementation.

- Because of the new environment, telecom/IS managers need to develop skills as proposal evaluators and contract negotiators. Working relationships must be developed across departmental lines. The planning process may take more than a year, and as much as one-third of the project budget.

- Items to be considered in the planning process are described in detail in this section and are represented in Exhibit V-1.

B. CRITERIA FOR DECISION TO UPGRADE/REPLACE/INSTALL EQUIPMENT

1. ORGANIZATIONAL ISSUES

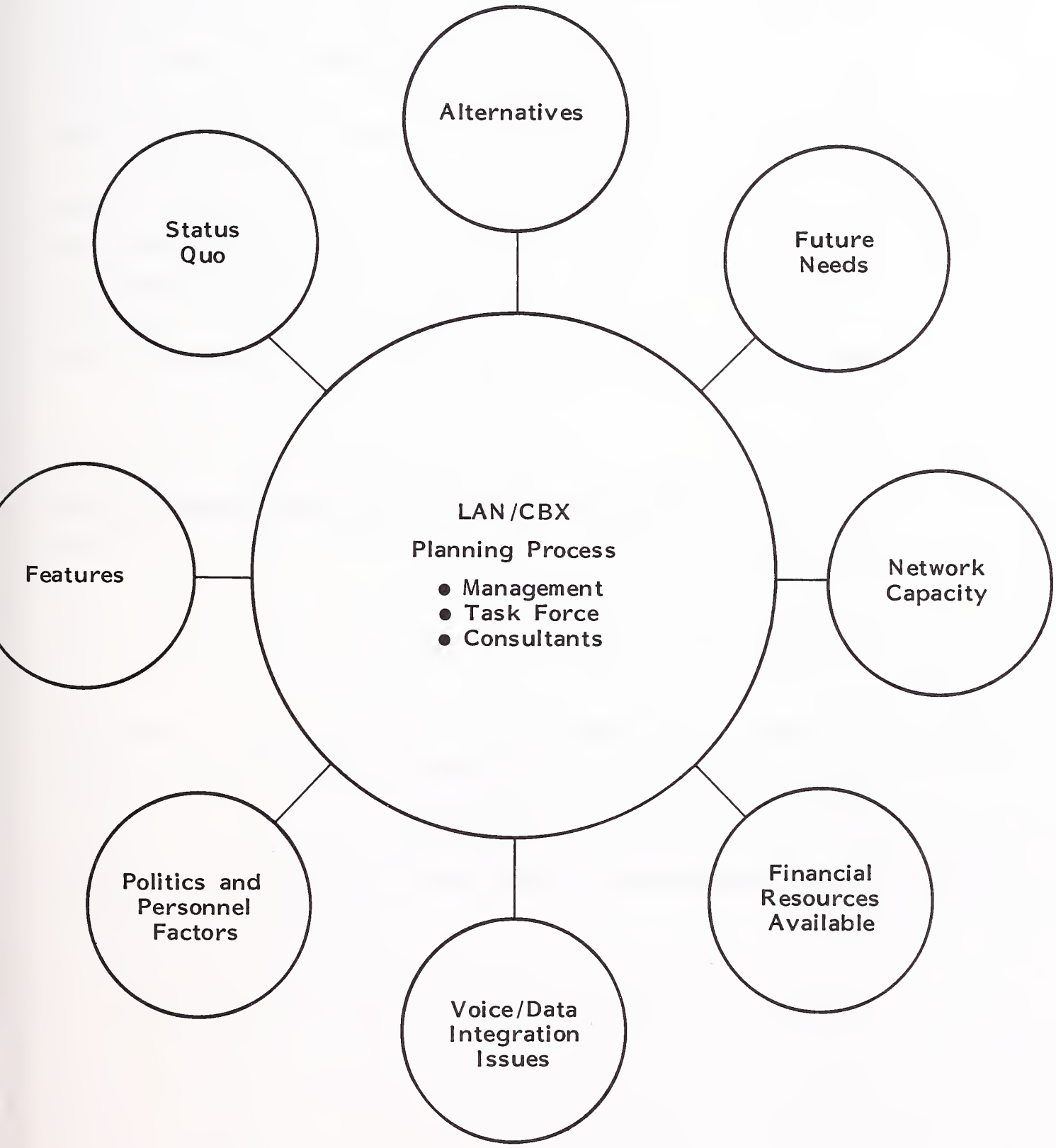
- A company recognizes a need to remain competitive by installing modern facilities.

  - The company may be observing increased profits from its rivals due in part to the plant's modernization and to the implementation of productivity enhancements.

  - Corporate management is not getting the information it needs quickly enough to support its decisions.

EXHIBIT V-1

THE LAN/CBX PLANNING PROCESS



- It is believed that improved internal communications and the benefits of an integrated office automation system will affect productivity and profitability in a positive way.

- The company is relocating and has an opportunity to invest in assets. A relocation will usually require new systems and structures. Office automation equipment and communications facilities are needed; this is a chance to start with a fresh approach rather than adapt pre-existing conditions to a new environment. This is an opportunity to invest in "office-of-the-future" assets.

- The company has increasingly decentralized as it has expanded. Internal information traffic patterns have changed. It is an appropriate time to take a systems approach to information management. With the evolution toward dispersed sales, manufacturing, and administrative staff (and possible multi-national locations), lines of communication are altered and expanded. New ways of maintaining contact are needed.

- The corporate imagery requires using advanced technology. The personnel in some industries wish to create impressions in the minds of others or feel a need to use tools that match a self-image. These are perceived as enhancing business functions.

2. FINANCIAL ISSUES

- Tariffs have increased and maintenance costs are up. The increasing cost of communications has attracted attention, and something must be done. LANs/CBXs may offer cost savings benefits.

- Existing equipment has been fully amortized and adds nothing to corporate assets.

3. EQUIPMENT ISSUES

- The company has added noncommunicating terminals and freestanding systems. The adoption of PCs, plus the sharing of expensive peripherals such as printers and storage devices, inevitably leads to networking considerations. There is a desire to share information and resources as part of an overall office automation strategy.

- The current communications capacity is limited. A system that was adequate before may have reached its limits for upgrading. Merging data and voice, plus increased traffic, slows system response time and affects productivity. Service quality has deteriorated to unacceptable levels. Mean time between failures has increased to unacceptable levels.

- The reasons for wanting change should be kept in mind throughout the planning process.

C. CURRENT AND FUTURE REQUIREMENTS REVIEW

- The first step is to see the "big picture." Understand the company's communications channels by conducting a needs assessment. Review the status quo.

  - Examine costs in each area: voice/text/image communications, data processing, word processing.

  - What kinds of information are transmitted today? Between whom? How often? What kinds of information are expected to be transmitted tomorrow?

  - What services are used (WATS, FX, Telex, facsimile, etc.)?

- How is equipment distributed? What is the area to be served by the new system?

- What are the company's growth plans?

- Have communications been adjusted to adapt to system limitations?

- What is the scenario if the present situation continues?

- Consider the following steps in a needs assessment procedure:

  - Conduct an equipment inventory of leased and owned equipment, wiring, and so on. Determine age, functional capacity, and any changes in how equipment has been used since its original purchase. Check purchasing records and asset tags, and do a physical walk-through.

  - Prepare a formal user survey. Determine user likes and dislikes about the current system. Determine which features are used, which are not used, and which are desired. Determine if users think integration of voice/data/office automation functions would truly be useful.

  - Survey department managers and executives to determine operational changes and expansion plans that will affect future telecom needs. It would be unwise, for example, to put resources in an area the company plans to phase out.

  - Obtain call counts from the local telephone company to determine trunk utilization. Determine other traffic statistics: Telex, FAX, data exchange, data base access.

  - Map the organizational structure showing work relationships. Show physical and electronic communications links and network calling patterns. For example, how are interdepartmental memos dis-

tributed? What are the heavy and light internal and external traffic routes? How is Telex traffic originated? What are the informal information flow paths? Where is there duplication of effort (e.g., duplicate files)?

- Determine key problem areas that require solutions. Is work processing backed up? Are external communications efficient? Is marketing getting its materials out?

- Determine special circumstances that need to be addressed. For example, reliability in hospital settings is a critical issue; security in other settings is another critical issue.

- Determine any physical requirements/constraints: Is there room for equipment cabinets? Is air conditioning or emergency power required?

- Based on the above information, prepare technical and financial analysis statements. Project usage and expected equipment replacement costs, assuming status quo.

- It is politically important to involve personnel at all levels. Involved staff is more likely to accept and endorse recommendations. Define objections and determine why people are in favor of the change. Task force participants should seek information from personnel in their departments and should keep them informed.

- If a needs assessment does not lead to new system selection, the process will help determine how best to manage present systems. The telecom/IS manager may learn, for example, that desired features are available but are not being used.

- Understand corporate goals. Orient the telecommunications plan to the corporate strategic plan and divisional plans, using the languages and the time frame of those plans.

- Review annual reports and business plans, and interview department heads.

- The telecom area must be seen as an asset. What is the long-range telecom plan? How does it fit the overall direction of the company? How does it affect profits?

- Determine projected costs of continuing business as usual. If functions are combined (voice, data, building security, energy control), would money be saved?

- If data and voice are merged now, will organizational problems be avoided later?

- Is it possible to project quantifiable productivity gains or to set improvement goals as a result of a new system?

- Analyze corporate financial considerations.

  - Understand the company's financial situation.

  - What funds are available to implement recommendations? What limitations are there?

  - Does the company have policies governing the leasing, renting, or purchasing of capital equipment?

  - What is the corporate fiscal year and budget cycle?

  - Assuming ownership, what will be done with the equipment being replaced? Should it be sold or used elsewhere?

- Recognize the influence of the corporate culture, personnel, and political factors.

  - Perhaps the most difficult and wide-reaching issue to consider in this area is: "what organizational changes make sense for addressing the future telecommunications, data processing, and information system needs of the company?

  - What is the executive attitude toward office automation?

  - What support or animosity will the plan attract?

  - What skill levels are represented in the work force and how will these benefit or hinder implementation? What adjustments must be made?

  - Is the attitude of personnel concern, fear, or acceptance? Will there be any labor relations implications?

  - How do corporate personnel policies relate? Are there goals to increase, maintain, or decrease head count?

  - What is the corporate self-image? Will self-image dictate functional, design, or stylistic decisions?

  - How will shareholders react? Will action affect dividends?

  - In the evaluation phase, gather and organize vendor information, attend trade shows, and talk with industry peers to gain perspectives. Evaluate all practical alternatives generically (choices will be narrowed later) and evaluate desired features.

- Consider the features of:

  . CBXs: Least-cost routing, message detail recording, voice store and forward, electronic messaging, paging, security levels.

  . LANs: Speed, capacity, gateways, integrated building services.

  . Data PBXs: Separate voice and data communications, least expensive solution, simplest technology, network-switched.

- Consider the need for special capabilities such as special interfaces, function-specific workstations, on-desk teleconferencing?

- Avoid the tendency to buy "hype" and applications in search of a need.

- Conduct an on-site evaluation of systems being considered; interview users of these types of equipment, particularly those in the same industry or those whose companies have structures similar to yours.

- Prepare preference charts and a decision matrix to aid in the feature evaluation, using Exhibit V-2 as a reference.

- The decisions to be made within solution options are depicted in Exhibit V-3.

D. LAN OR CBX?

- The choice between a LAN and an integrated voice/data CBX is critical because it determines the backbone of the office automation system. The decision criteria for each technology are summarized in Exhibit V-4.

EXHIBIT V-2

PREFERENCE CHART

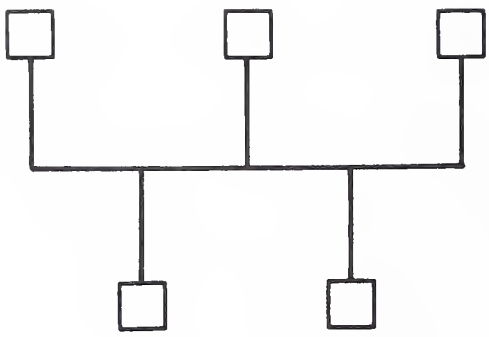
Comparison (A. / B.)	Cost	Capacity	Expandability	Facility Requirements	Personnel Status	Training Requirements	Installation Requirements	Maintenance	Vendor Evaluation	Availability	Numeric Value	Weighting Factors
Cost												
Capacity												
Expandability												
Facility Requirements												
Personnel Status												
Training Requirements												
Installation Requirements												
Maintenance												
Vendor Evaluation												
Availability												

- Working down column "A," enter numeric value for preference of "A" over "B."
- Add numeric values across columns and enter in appropriate column.
- Average numbers to get weighting factor.
- Apply weighting factor against features of present system and all feasible alternatives.

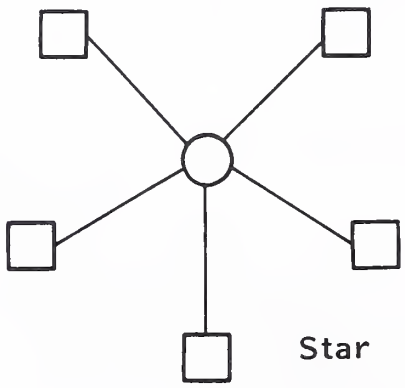
EXHIBIT V-3

DECISIONS WITHIN SOLUTIONS

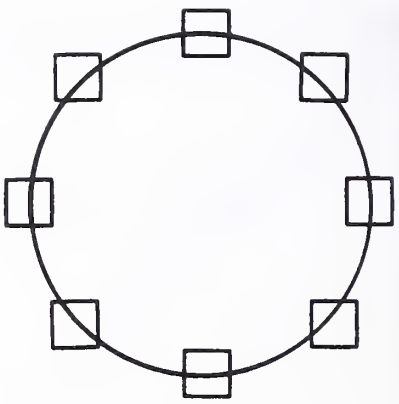
TOPOLOGY*



Bus



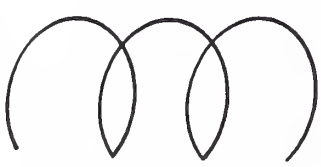
Star



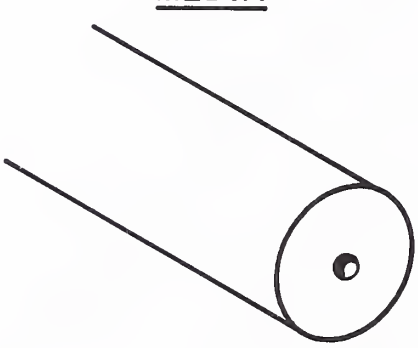
Ring

*□ = Terminal of Peripheral

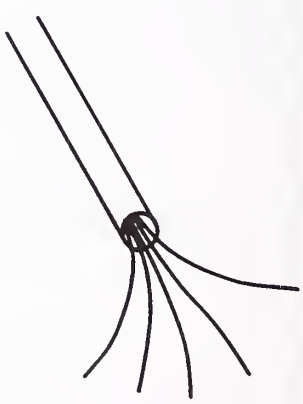
MEDIA



Twisted Pair



Coxial Cable



Fiber Optics

ACCESS AND OTHER CONSIDERATIONS

Token Passing
CSMA
CSMA/CD
Polling
Baseband
Broadband
Interfaces
Software

EXHIBIT V-4

DECISION CRITERIA

- Select LAN
  - Mainframe-to-Mainframe Links
  - Extensive Data Base Updates
  - High Speeds Needed Due to Number of Users
  - High Speeds Needed for Video, Color Graphics, Special Applications
  - Protected Investment in PBX
  - Redundant Networks Desired
  - New Building Construction
- Select CBX
  - Low Speed Okay
  - Sporadic Terminal/PC Access to Mainframe
  - Physical Constraints on New Cable Installation
  - Frequent Moves
  - Integrated Voice/Data Features Desirable

- The features and benefits of LAN and CBX must be evaluated, based on the requirements of today and tomorrow. Apply the features and benefits of each to your situation.

- Defining a realistic projection of future networking needs will help ensure that adequate system capabilities are designed and that unnecessary expenditures are avoided.

I. CRITERIA LEADING TO A LAN SELECTION

- The user's company has invested in free-standing systems (PCs and peripherals), which carry a heavy workload, and now wishes to link the systems, sharing resources.

- Information is to be transported between mainframes.

- The data base is extensively updated.

- The user's company does not wish to replace or upgrade its recently installed PBX. (A data PBX solution may be appropriate in this case.)

- High-speed capacity is required to accommodate switched video, high-resolution graphics, other special applications, or a large number of users.

- The company wants separate data and voice networks for security reasons.

- The building or campus is already wired for CATV. Savings are possible on the installation of a LAN.

- A new building is being constructed, or an old building is being extensively renovated. Cable can be installed economically.

2. CRITERIA LEADING TO A CBX SELECTION

- The user's company is encouraging widespread use of PCs.

- Terminals or PCs are used for relatively low-speed access to remote or mainframe computers for electronic mail, word processing, or routing data base inquiries such as inventory/price checks.

- The network will be used experimentally for prototyping data communications applications as preparation for long-term solutions.

- Building construction prevents cabling. Solid concrete walls, cable conduits, and restrictive local building codes prevent new wiring installation.

- People and departments move frequently. CBX can accommodate moves easier than LAN. Central maintenance is desirable.

- The company wants features of integrated voice/data CBX that are not available on dedicated LANs.

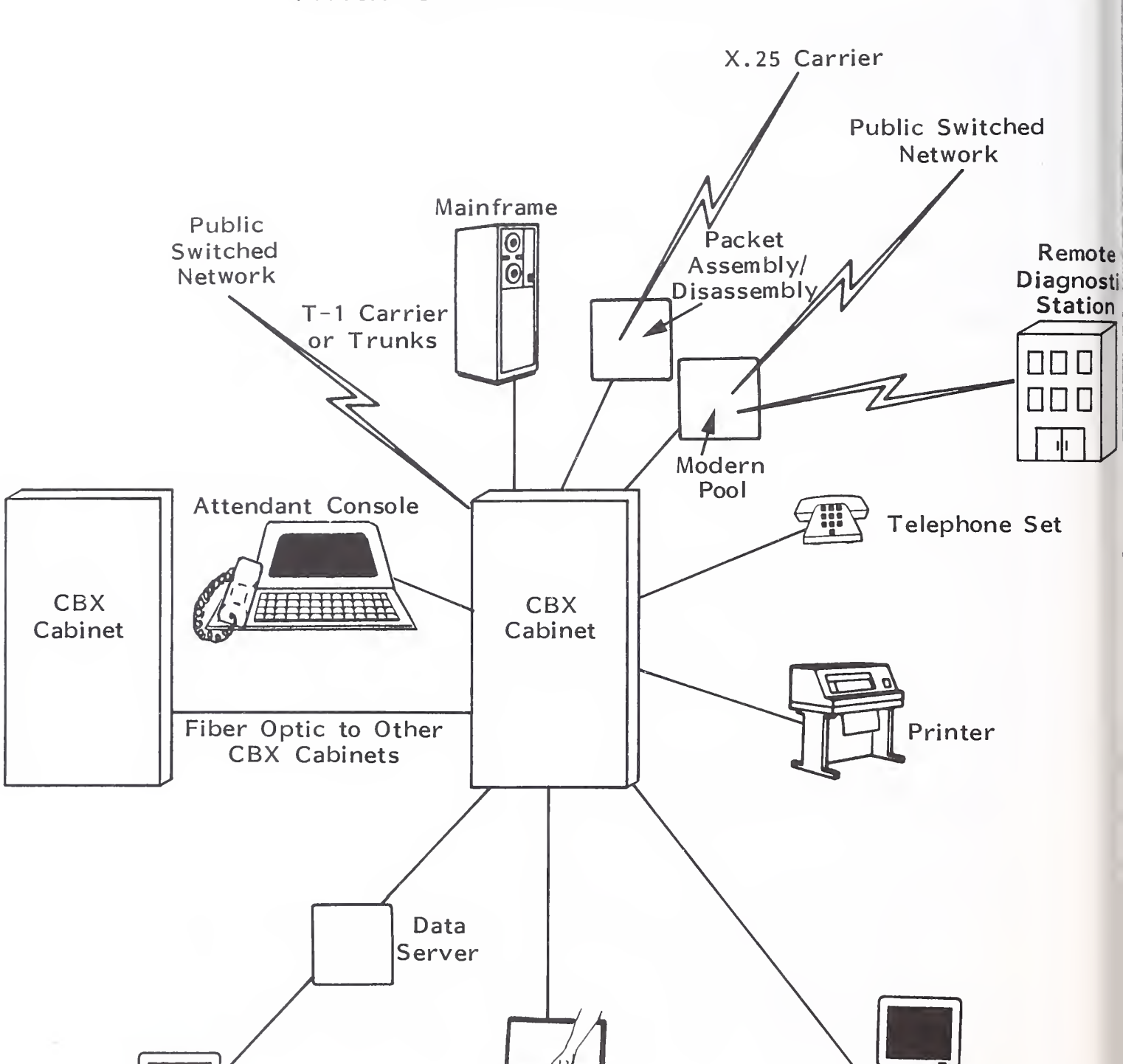
- A typical CBX configuration using star topology is shown in Exhibit V-5.

E. DECISION ISSUES FOR LANs

- No one configuration is suitable for every situation. Indeed, within the same corporation, different units may have different networking needs. It is possible to install different systems within the corporation. Special applications, such as LAN's controlling factory automation functions, also need to be considered.

EXHIBIT V-5

TYPICAL STAR CBX CONFIGURATION



- The central decision issues for LANs, as summarized in Exhibit V-6, are topology, media, method of transmission, method of access, and interfaces.

I. TOPOLOGY

- The characteristics of each LAN topology--star, ring, and linear bus--are summarized in Exhibit V-7.

a. Star

- General description:

  - It has the simplest configuration.

  - CPU functions as a message switch.

  - It is traditionally used for point-to-point links between CPU and all devices connected to the mainframe. It is also the traditional PABX configuration.

- Indicators:

  - It is appropriate when the host contains applications programs and data bases that must be accesssed by remote terminals.

  - The system can be expanded up to the CPU limit. Beyond that, however, hardware costs may be prohibitive.

- Negatives:

  - This configuration puts the heaviest burden on the host. Response time may fall below an acceptable range as terminals on the network communicate through the CPU to each other.

EXHIBIT V-6

LAN DECISION CRITERIA

TOPOLOGY -- the schematic of the network

MEDIA -- the type of wiring

TRANSMISSION METHOD -- analog or digital, base-band or broadband

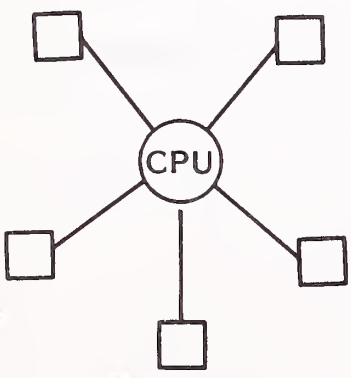
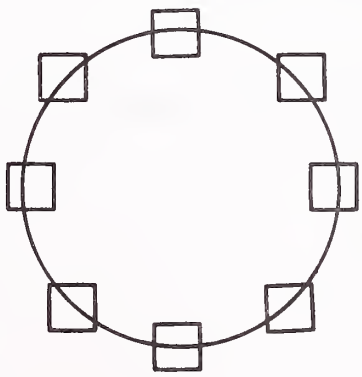
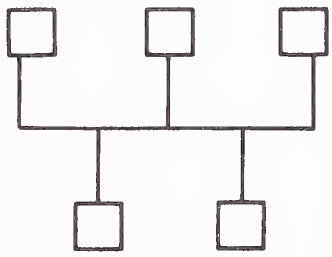
ACCESS METHOD -- how does data get on the network without colliding with other data?

INTERFACE/STANDARDS -- how easily can you add to the network?

SOFTWARE DEVELOPMENT -- who does it?

EXHIBIT V-7

LAN TOPOLOGY

	STAR	RING	BUS
Messaging	CPU is Message Switch Good for Mainframe Access	All Nodes Forward Messages	Central Media Economically Used. Best for Short, Bursty Trans-missions
Expansion	Limited Expansion	Expansion Difficult	Expansion Easy
Control	Heavy Load on Host	CPU Not Required	Central Controller Not Required
Reliability	Net Goes Down if CPU Fails	All Nodes Have Intelligence. Node Failure on Old Systems Causes Network Fault; New Systems Have Built-in Redundancy	Media Works De-spite Station Failure
Integration	Voice/Data	Integration Difficult	Easy Combination of Voice/Data/ Video
Simplified Schematic			

□ = Terminal or other device.

- Higher wiring costs are required since each station is directly connected to the CPU.

- It is susceptible to catastrophic failure. When the CPU fails, the entire network is disabled.

b. Ring

- General description:

  - All nodes participate in message forwarding.

  - Each node has intelligence and is able to detect beginning and end of the message and to inject its own message into the stream.

- Indicators:

  - The CPU is not required to switch or relay messages.

  - Newer systems offer redundant controllers with high equipment reliability. On older configurations, failure of one relay point on the ring may cause transmission halt.

- Negatives:

  - Ring expansion is difficult, requiring hardware and software changes at each station.

  - It is not easily adaptable to integration of voice, data, and video.

c. Bus

- General description: All devices share a common broadcast channel.
- Indicators:
  - The system does not require a central controller.
  - It is very economical in short, bursty traffic situations between stations. Connecting media is always utilized.
  - Connecting media function is independent of operational abilities of individual stations.
  - It is easily expandable or modified.
  - The system connects with outside nets.
  - It easily combines video, data, and voice.

2. MEDIA

- The characteristics of LAN media--twisted pair, coaxial cable, and fiber optics--are outlined in Exhibit V-8.
- The choice of LAN media should consider the ease of:
  - Installation.
  - Maintenance.
  - Reconfiguration.

EXHIBIT V-8

MEDIA

	TWISTED PAIR	COAXIAL CABLE	FIBER OPTICS
Installation	Usually already installed. Least expensive.	Sometimes available. Is generally expensive.	Difficult. Needs special alignment techniques. Expensive.
Bandwidth	Limited speed. Distance sensitive.	High speed. Wide Bandwidth.	Highest speed, widest bandwidth (full motion switched video possible).
Security	Susceptible to tapping, electromagnetic interference.	Resistant to tapping, interference.	Immune to interference, tapping.
Maintenance	Troubleshooting often difficult.	CATV experience is an advantage.	Difficult - technology still evolving.
Strengths	Cheapest media.	Great capacity. Physically durable; track record of experience.	Greatest capacity. Highest level of security.
Weaknesses	Susceptible to RF.	Expensive.	Technology is relatively new - adds expense.

- The expense of service disruptions caused by later decisions to upgrade can be avoided by making the correct initial decision.

a. Twisted Pair

- General description:

  - The medium is already installed in most existing buildings.

  - It is reliable up to one Mbps for one kilometer.

- Indicators: It is the least expensive medium.

- Negatives:

  - Bandwidth and distance are limited. It loses power over distance without repeaters, which adds to installation costs, thus mitigating savings.

  - Low speed is inadequate for full-motion video, high-speed graphics, or high-speed data links.

  - It needs to be shielded if exposed to electromagnetic/radio frequency interference from transformers or transmitters.

  - It is susceptible to wiretapping/security breaches.

  - Troubleshooting and fault isolation are often difficult.

b. Coaxial Cable

- General description:
  - This medium features large bandwidth and high speed. It carries 10 Mbps of data plus simultaneous integrated video and voice channels.
  - It may be available in buildings wired for CATV.
- Indicators:
  - It is suitable for relatively long distances.
  - It is resistant to electromagnetic interference.
  - It is resistant to tapping/security breaches.
  - It is physically durable.
  - A key advantage is its record of use in the CATV industry, which leads to adequate supplies of cable, parts, connectors, and technicians having experience in installation and maintenance.
  - Many new buildings are being wired for CATV services, a possible savings opportunity.
- Negatives:
  - This medium is expensive.
  - Installation costs are high, since it is best installed under computer floors, in ceilings, or buried between buildings in a campus setting.

c. Fiber Optics

- General description:
  - This medium features the widest bandwith.
  - It offers high speeds, typically 200 Mbps for up to two kilometers without repeaters.
  - Emerging standards for connectors, installations, and service are making fiber optic systems more attractive.
- Indicators:
  - It offers lower cost than coaxial cable but higher than twisted pair.
  - It is not affected by electromagnetic interference and can be installed in heavy industrial equipment settings.
  - Undetected security breaches are virtually impossible.
- Negatives:
  - Connecting technology is only recently becoming more practical and cost effective.
  - Installation and maintenance is difficult. Couplers, connectors, and splices require special alignment techniques.
  - Scales of economy in the production of lasers and LEDs used for light transmission are just now appearing.

3. TRANSMISSION METHOD

- The third decision in selecting a LAN is determining which of two methods--baseband or broadband--is best for particular needs.

  a. Baseband

- This method uses time-division digital transmission techniques, meaning that one signal is carried on the cable.

- Indicators:

  - It can use any topology.

  - Smaller systems do not require a central controller.

  - It is good for connecting computers, word processors, or other devices in a limited area.

  - Since it is fast and accurate--10 Mbps--it offers a low error rate.

  - It is relatively trouble-free and easy to maintain.

- Negatives:

  - CATV equipment cannot be used.

  - Distance is limited to approximately one mile without expensive repeaters.

  - Connecting to other networks requires special equipment.

b. Broadband

- Data is multiplexed on analog radio frequency carriers.
- Indicators:
  - This method uses existing and proven CATV cable and electronics. Network distance can be expanded to 80 KM with CATV repeater amps.
  - Literally hundreds of channels, including wideband, can be supported for voice and full-motion video.
  - It supports contention protocols (see below).
  - Error rates are low.
  - The data rate is virtually unlimited--10 Mbps per channel.
- Negatives: It is more expensive than baseband because radio frequency modulation techniques are more complex. Node connections are expensive because modems are high priced.

4. ACCESS METHODS

- The access method essentially is the "traffic cop" controlling how stations use the shared medium.
- The contention (random access) method is suited for bus networks.
- The carrier sense multiple access (CSMA) method "listens" for other traffic and waits for an opening to send messages.

- When joined with collision detection (CD), the method becomes CSMS/CD. In this method, a node listens to its own traffic. If it detects a collision, it resends the message.

- Positive: Contention allows distributed network access. Terminals and other devices can be added without the need to adjust the central controller.

- Negative: In heavy traffic situations, response time is slowed.

- Token passing controlled access is used primarily in ring topology networks. Authorization to carry messages is sent from node to node. This is the most widely used method.

- Polling is managed by the central controller, which looks for messages waiting to be sent from each station.

  - This method is used in star and bus networks and avoids collisions.

  - Negative: Network efficiency is lower, since no messages are transmitted during polling interludes.

5. INTERFACES

- Compatibility issues:

  - Are you limited to the vendor's equipment?

  - RS-232-C is standard on many devices (printers, terminals, etc.).

- X.25 allows simultaneous interactive applications. It is not well-suited for high-speed CPU-to-CPU transfers or file transfers.

- Bus or channel interface: LAN offers direct connection between network and CPU.

- Connections to public data networks and other LANs may require special interfaces.

6. SOFTWARE

- There may be a need for customized software, vendor provided or in-house developed.

E. DATA PBXs AND OTHER ALTERNATIVES

- In situations where integrated voice and data are not necessary, there are alternatives to be considered. These alternatives, developed as data processing applications, include:

  - Front-end processors, which control CPU access for a limited number of terminals.

  - Data PBXs, which are engineered to switch data throughout a network, much as PBXs switch voice.

  - And data over voice (DOV) units or local area data transports (LADTs), which transmit data on the same wiring that carries voice, using multiplexing techniques and excess capacity.

- Average costs per port on these alternatives are a fraction of similar connections on upgraded PBXs, or on LAN- or CBX-integrated systems.

- These alternatives economically use existing or spare building wiring. At higher speeds, this may prove to be inadequate.

- Electromagnetic interference may also be a problem.

- Another alternative suitable for some settings is a supermicrocomputer. Supermicros can replace connections between PCs operating in work clusters and can also replace minicomputers-to-PC LAN links. Supermicros, supporting several users, are approximately half the cost of a PC LAN. In growth situations, however, a LAN offers a better solution because expansion can be incremental.

- There are tradeoffs between advanced, specifically designed solutions and the alternatives discussed, and these tradeoffs should be carefully evaluated by the user.

F. CRITERIA LEADING TO A DATA PBX OR ALTERNATIVE

- Although newly developed technologies offer certain advantages for users, many situations simply do not require these approaches.

- The user is well advised to consider using simpler technology, assuming that network requirements are adequately served. Also, other issues may need to be evaluated.

  - The financial resources for an integrated voice/data CBX are not available.

- The company has recently upgraded its voice PBX and is satisfied with its service.

- The company does not want to "put its eggs into one basket." It wants to separate its data and voice communications to prevent a total collapse of its operations should one system fail.

- The IS and telecom departments and/or budgets cannot be merged for political or bookkeeping reasons.

- The company plans to move in a few years, and alternative solutions offer a good, cheap, short-term fix.

- The work environment features clustered systems: company-wide networking is not required.

G. NETWORK DESIGN

- There are several options for network design.

  - The telecom manager has the skills/staff/time to do the design.

  - Teleprocessing equipment vendors provide network design services.

  - Independent consultants provide design services.

  - Time-share network design software is available from several corporations (such as Contel Information Systems and the Aries Group).

  - Microcomputer software packages can be purchased.

- Computer-assisted network design offers an opportunity to maximize network configuration and save money doing it.

H. THE REPORT TO MANAGEMENT

- Once a course of action has been determined, the telecom manager must justify the recommendation to management.

- Timing is based on corporate practices rather than on a structured plan. The report to management may be prepared before requests for proposals (RFPs) are issued, or it may incorporate vendor input from solicited proposals.

- Although a verbal report may serve in some situations, the expenditure of significant funds usually requires a formal, written report. Preparing such a report helps ensure that alternatives have been evaluated. Furthermore, the telecom manager will be prepared for questions.

- A full financial analysis should be included.

The report might follow the format outlined below.

- Management overview, condensing the essence of the report in one or two pages.

- Alternatives considered, demonstrating that various options were evaluated and one was chosen as the best solution.

- Significant factors, giving further evidence of a rational, sound process. The analysis would show how factors were weighed and evaluated. The significant factors would be those that surfaced in the analysis outlined earlier in this report.

- Recommendations, unifying the system recommendation by describing the network and linking the various pieces of the project.

- Amendments: Fact sheets, graphics (which might be used as overhead slides), copies of the RFP, product literature, and any other element that enhances understanding of the process and the recommendations being made.

I. REQUEST FOR PROPOSAL (RFP/REQUEST FOR QUOTATION)

- After the decision has been made about what technology will best serve the company's needs, a request for a proposal is developed.

- The physical inventory may show a preponderance of a certain manufacturer's equipment or class of equipment, indicating the RFP should be issued to a limited number of vendors that can design a system incorporating these in-place resources.

- Corporate culture may dictate limits to the vendors invited to bid.

- The RFP provides detailed system specifications.

- The RFP establishes the format for responses, thus facilitating evaluation and comparison. A suggested format is outlined in Exhibit V-9.

- The RFP will specify system pricing structure. It is desirable to have a detailed pricing schedule, allowing comparative value analysis. You may want information on leasing, renting, purchasing, or on all of these options.

EXHIBIT V-9

SUGGESTED PROPOSAL FORMAT

Cover Page

Table of Contents

I. System Overview/Executive Summary

II. Equipment Specifications

III. Service/Warranty Information

IV. Expansion Capabilities

V. Delivery and Installation Schedule

VI. Detailed Financial Breakdown

VII. Vendor Profile

VIII. Supporting Information and Literature

- Out of fairness to all vendors and to limit time on the selection process, the RFP should limit bidding to existing, available products.

J. VENDOR EVALUATION

- After the selection process has been narrowed, the telecom/IS manager will evaluate two, three, or more vendors responding to the RFP.

- The goal is to get the cheapest price for a system fully meeting the needs. Determining the best price may not be easy.

  - Different vendors may suggest leasing or outright purchase. This is why the manager should be specific in designing RFP requirements.

  - Different vendors may have exceptional offerings but be unable to bid on the entire package.

  - Vendors may include items in their response which are not standard in other proposals.

- There are several key considerations in evaluating vendors:

  - Does the product fit specific identified needs, now and in the future, or does it have applications in search of a need?

  - What are the vendor's plans for the future? Does the vendor intend memory upgrades for more applications, integrated protocol conversion, or software upgrades?

  - Is service readily available? Are spare parts quickly shipped? Is remote diagnostic capability reliable? Does the company plan to handle its own growth dynamics?

- Do sales and engineering staff appear to know their business and product line? Can they answer your questions adequately?

- Is the company stable and on solid financial footing? Has there been constant personnel turnover? In the event that they go out of business, are your future needs guaranteed?

- Are user references good, and have there been successful installations elsewhere? (If not, can you afford to serve as a test site?)

- Is training available from, or through, the vendor?

K. CONTRACT NEGOTIATION

- Contracts are usually written by vendors in their own best interests, but they are always negotiable. Make sure that:

  - All equipment is included.

  - Guarantees, service, and spare part availability are specified.

  - Performance standards are clearly defined.

  - An installation schedule is specified, along with bonus amounts (if the vendor meets these dates) or penalties (for failure).

  - There is an arbitration clause for dispute resolution.

  - Financing arrangements are specified.

- Before the agreement is signed, legal department review is mandatory.

L. MAINTENANCE CONTRACT

- Concern for system reliability has been a deciding factor between system ownership and rental of equipment. Adequate maintenance agreements address this concern.

- Vendor evaluation criteria apply to the maintenance contractor. The vendor may serve as the maintenance agent. Other key issues include:

  - Guaranteed response time and service personnel availability.

  - Convenient location of service facilities.

  - User diagnostics/remote diagnostics ability.

  - User maintenance assistance and training.

- Consider the following questions:

  - Does the agreement cover extraordinary events, such as lightning, floods, or other acts of God? If not, does your business insurance offer protection?

  - Are there additional costs involved in changes, moves, and upgrades?

  - Is the cost reasonable? What are the payment options? How would a blanket service agreement compare to a time and material arrangement?

M. IMPLEMENTATION

- After vendor selection, contract negotiation, and signing of agreements, the implementation phase begins.

- Generally, it is a good idea to follow the three-fold approach to implementation:

  - Prototype.

  - Pilot.

  - Production.

- This strategy follows a progression of implementation with low investment at the outset when the risks are greatest.

1. PROTOTYPE

- One user community is selected to test portions of the implementation plan. This stage is designed to discover and assess technical weaknesses.

- Several competing products may be tried to determine what is best for the company as a whole. This can be accomplished under short-term lease arrangements.

2. PILOT

- This stage attempts a wider implementation. Piloting seeks to identify other issues (organizational, political, personnel--in general, human rather than technical factors) that need to be considered before full implementation. This is a further "shake down."

- This stage may also be used to test assumptions on "before" and "after" productivity levels.

- Sufficient time is needed to allow users to become comfortable and competent with the equipment.

3. PRODUCTION

- This stage attempts full implementation. The original plan may be modified. Elements here include:

  - Installation/cut-over schedule.

  - Training plan for use.

  - Future enhancement planning.

4. REVIEW

- Finally, there is a post-implementation review to determine if projected benefits are being actualized.

- If benefits are not actualized, the review should help determine what can be done to improve the system.

N. OPERATIONAL ISSUES

- Once the functional and technical basis of the network is understood by the user, operational issues need to be addressed. This section outlines these issues generically.

- In INPUT's opinion, operational issues are a major reason for delays in the installation of a LAN/CBX system.

1. GEOGRAPHY AND TOPOLOGY

- It is important for users to understand the network transmission medium (geography) and the demands of the configuration (topology).

- The design of the cable system should clearly identify the following segments:

  - Underfloor cabling.
  - Overceiling cabling.
  - Surface raceway cabling.
  - Cabling through utility rooms.
  - Cabling through elevator shafts.
  - Cabling through public (employee) hallways.
  - Cabling into offices.
  - Different cabling segment protection schemes.
  - Different cable segment testing methods.

2. FEEDERS AND EXTENDERS

- Based on the above cabling scheme, it is necessary to make an economic tradeoff in trunk amplifiers and line extenders.

- Depending on the type of amplifiers used, there may be specific limits on the quantity that can be installed in series (cascade).

- Further there may also be specific limits to the total number of amplifiers installed throughout the network.

- These limits are usually associated with extenders which tend not to discriminate between usable signals and noise. Instead, they amplify everything at the input side. It is therefore necessary that the design of the network take both the cascade limit and the noise characteristics into account.

3. BEWARE THE LIMITS

- It is important that any future growth bounds of specific branches of the total network be understood as best as possible. Regardless of amplifier type used, its accessibility and space factors require careful consideration. A typical line extender can be a foot long, up to a foot wide, and protrude from the wall a foot. It will have cable going into and coming out of it. Space considerations can be very important.

- This hardware is mounted on a board bolted to a wall or arranged in a false ceiling; the space requirements can be substantial. Space requirements for cabling systems (in addition to nodal space requirements for devices) can be one of the most difficult design tasks.

4. NODAL SPACE REQUIREMENTS

- Planning device locations is required. Organizational changes often lead to office changes. These in turn may require relocation of LAN/CBX devices and nodes.

- For planning purposes, it is necessary to install as many taps as possible so that the least amount of reconfiguration is required when nodes have to be moved from one location to another.

5. RUNNING THE MEDIUM

- A cable route must be found that provides reasonable access for installation crews and for later maintenance activity. The route can be through vertical riser shafts, above ceilings, and below raised floors.

- Cables can be heavy and must be tie-strapped to anchor points. Signal loss must be avoided by carefully cutting, splicing, and insuring that cables have minimum sweep radii.

- During installation it is often desirable to supervise the work being performed. It is unlikely that the installation crew is composed of design engineers. Installers may violate sweep radius specifications in tight places. They may also find they have insufficient cable available for continuous run and may use a straight splice. The first splice between amplifiers may not be a reason for concern, but the second, third, or fourth unspecified splice may prove disastrous.

6. FAMILIAR PIECES

- The hardware that users deal with in operations of LAN/CBXs are familiar. They consist of:

  - Amplifiers.

  - Splitters.

  - Couplers.

- Power supplies.

- Key sets, etc.

- Each component has a discrete function and cannot be substituted for a functionally similar component. One cannot substitute a 12 db coupler where the design calls for a 16 db coupler.

- The mere quantities of these components involved in installation can be substantial, and they have considerable street value. It becomes important to have an effective inventory control scheme, involving an accurate count of all parts and components assuring there is adequate stock to install the systems designed.

7. INSPECT THE SUPPORT AND PROTECT THE JUNCTION

- Each component mount on the wall or boards must be inspected. In most instances, a metal bracket, called a "standoff," is first mounted to the wall. The component is then bolted to the standoff. If the standoff is not securely mounted, twisting is possible with relatively little force. This can mean a broken connection sometime in the future.

- Similarly, the junctions need to be protected to avoid future operational failures of the system. It is mandatory that either hot or cold tubing be used, instead of plastic tape or spray-on sealer, to protect all junctions.

8. APPROACHING CUT-OVER

- Considerable testing is required prior to cut-over. Testing is a reiterative process that leads to refinement.

- Testing in this case consists of a large number of hardware and software components. It is possible that small changes may be made during the testing process.

- Further system optimization may be achieved by tuning the interface unit cards and its software.

- A comprehensive test plan developed with vendor help needs to be followed before the system can be handed over to users.

- It is necessary to keep a log of changes to avoid getting into a "loop," repeating tests and trials tried before.

O. OTHER OPERATIONAL ISSUES

- It is necessary to plan how the system will be administered. Consider these questions:

  - How is the maintenance agreement supervised? By whom?

  - Who does periodic traffic load analyses?

  - Who is responsible for developing procedures and maintaining documentation?

  - Who is responsible for system alteration as needed for efficiency, accuracy, and lower cost alternatives?

  - How are equipment failures tracked and reported? If a rate of performance is guaranteed and equipment doesn't deliver, what recourse does the company have with the vendor?

  - Who is the telephone company liaison keeping the system interface functioning?

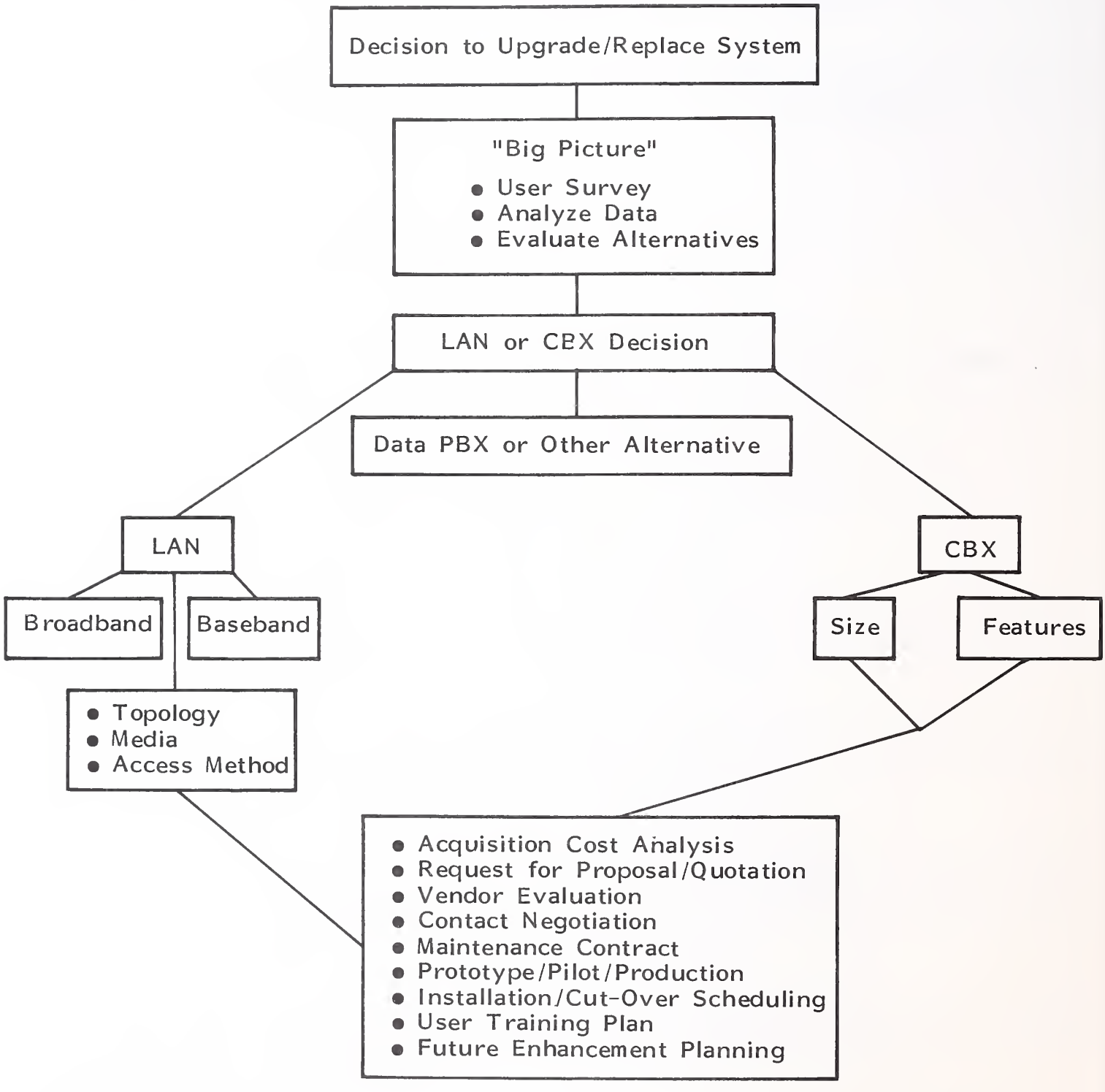
- Who monitors insurance needs, keeping policies up to date with system changes?

- How will users, attendants, employees, and managers be trained and familiarized with the system's features?

- The steps to be taken to upgrade a telecommunication system are summarized in Exhibit V-10.

EXHIBIT V-10

STEPS IN THE DECISION PROCESS



VI CURRENT AND FUTURE ACQUISITION AND OPERATIONAL ECONOMICS

VI CURRENT AND FUTURE ACQUISITION AND OPERATIONAL ECONOMICS

A. ACQUISITION COST REVIEW

- Generally in a CBX/LAN acquisition there is a constant line-cost factor independent of system size and features.

- Integrated functions (voice, data, security, building, and energy management) means lower overall costs.

- On a typical LAN/CBX project as much as one-third of the budget may be applied to develop detailed strategic plans covering needs assessments, system configuration, and installation planning.

- Financial analysis of telecommunications capital equipment acquisition and operations should consider the following aspects in addition to actual cash costs:

  - Current telecom expenses, including use, maintenance, and equipment replacement.

  - The value of current equipment inventory, as a percent of corporate assets.

  - Telecom expense, as a percent of corporate operating costs.

- Interest expense on capital expenditure purchase/lease.

- Availability and impact of investment tax credit.

- Evaluation of future price trends, upgrades, and expansion.

- Equipment pricing by various vendors will include or omit elements of the equipment configuration. Exhibit VI-1 provides parameters for developing user-specific worksheets.

B. OPERATIONAL COST REVIEW

- Maintenance can be 1.5-3% of network costs, on an annual basis.

- Consider the following in your operational costs review:

  - Determine the impact the new system will have on operational costs: additional staff, skill level/salary rates, training expenses, outside services, software upgrades.

  - Determine sales, property, and use tax liability.

  - Determine investment tax credit benefits.

  - Determine depreciation rates.

  - Determine the residual value of equipment at the end of the lease term.

EXHIBIT VI-1

CBX ACQUISITION COST REVIEW WORKSHEET

Equipment	$_____
Cabinets:	
Central Control Unit	$_____
Processor	$_____
Disk Drives	$_____
Line Printers	$_____
Switching Network Nodes	$_____
Multiplexers	$_____
Interfaces	$_____
Servers	$_____
Feature Modules	$_____
Call Detail Recording (CDR)/ Station Message Detail Recording (SMDR)	$_____
USF	$_____
EMS	$_____
On-Line Directory	$_____
Uniform Call Distribution/ACD	$_____
Word Processing	$_____
Other Features	$_____
Attendant Consoles	$_____
Terminal Equipment: Instruments/Workstations	$_____
Version 1	$_____
Version 2	$_____
Version 3	$_____
Peripherals	$_____
Data Access Boards	$_____
Data Interface Units	$_____
Modems	$_____

EXHIBIT VI-1 (Cont.)

CBX ACQUISITION COST REVIEW WORKSHEET

Packet Controller	$_____
Uninterruptible Power Supply	$_____
Cabling	$_____
Twisted Pair	$_____
Coaxial	$_____
Fiber Optics	$_____
Connectors, Wall Plates, Conduit	$_____
Spare Parts	$_____
Environmental Systems (Air Conditioning, Lighting)	$_____
Alarm Systems	$_____
Test Equipment	$_____
Services:	$_____
System and Network Analysis	$_____
Shipping and Handling	$_____
Installation Expenses	$_____
Construction	$_____
Wiring	$_____
Software Development/Customization	$_____
Warranty Fees	$_____
Training	$_____
Documentation	$_____

C. FUTURE REQUIREMENTS REVIEW

- Plans to expand the system should be described in the five-year telecommunications plan.

- The new system will participate in the continued growth of the corporation. The company may add locations or extend the network capability of the system to major customers.

- Future needs should be anticipated. These needs may be items on the "wish list" that were not implemented at the time of original system design, such as:

  - Advanced features.

  - Greater capacity.

  - New services.

- Exhibit VI-2 offers an outline for determining the cost of future system enhancements.

D. LIFE CYCLE COST REVIEW

- In view of the considerations that the installation of a LAN/CBX may require substantial capital/cash outlay, INPUT recommends that a user go through a two-step financial analysis process. The vendor selection criteria should be carefully augmented with the help of sophisticated financial analysis, preferably performed by the finance department of the user company. This section discusses the following essential steps:

EXHIBIT VI-2

FUTURE ENHANCEMENT PRICING WORKSHEET

Capacity/Limits of Present System	_____
Additional Trunks	_____
Cost per Single	_____
Additional Stations	_____
Additional Port Cards Needed?	_____
Cost per Line	_____
Cost per Group	_____
Service Expense	_____
Station Moves	_____
By Equipment Type	_____
Software Customization (per Hour Rates)	_____

- Lease decisions.

- Net present value methodology for system selection.

I. LEASE DECISIONS

- In the telecommunications industry, the concept of leasing is undergoing a face lift. This development marks the first time that lease agreements are being offered directly from a number of telecommunications equipment manufacturers providing the end user enormous opportunities. Most businessess, regardless of size, are not in a position to purchase telecommunications equipment independently, due to the hefty cash outlay.

- Leasing allows users to stretch smaller, fixed payments for equipment over a five- to ten-year period. It also allows users to keep its capital in a bank or assigned to another investment where it can either appreciate or be used for other more pressing needs.

- Leasing allows middle management the opportunity to acquire new equipment while sidetracking the corporate budgeting process, usually an annual event requiring considerable advance planning that is subject to internal political delays.

- Leasing also allows for off-balance-sheet financing, which some financial analysts contend improves a company's financial liquidity as related to purchasing equipment needs.

- Leases can be "customized" to fit the specific needs of the business, which is usually not possible with bank lending terms. For example, a lease can be either taxable or nontaxable. Usually, 100 percent of a lease can be written off as a business expense, wheras a cash or term purchase permits only about 35% percent write-off depreciation from income taxes.

2. NET PRESENT VALUE METHODOLOGY TO SYSTEM SELECTION

- In view of the considerations that multiple vendors may bid on the project with differing initial (fixed) costs and differing equipment additions during the next five-to seven-year time period, INPUT is of the opinion that net present value (NPV) appears to be the most appropriate financial methodology in comparing different system life cycle costs for the following reasons:

  - NPV allows a single-point comparison of different initial and recurring costs associated with difficult vendor systems.

  - It approximately discounts to a single point (number) any future additions of either fixed costs (capital costs) or changes in the recurring costs.

  - It can duly take into consideration the costs associated with salvage value, modifications, changes, replacements, and additions of hardware during the planning horizon--typically five to ten years.

  - NPV can also account for different methods of financing, e.g., financing from retained earnings (cost of equity) or financing from external sources such as banks.

  - NPV takes into consideration the time value of money.

  - Perhaps the single most important part of this methodology is that it allows a single-point comparison, i.e., it reduces "apples" and "oranges" to a single number so that they can be appropriately compared irrespective of differences in the maintenance agreements and their associated costs.

  - Last but not least, NPV is easily subject to sensitivity analysis, should different expenditure streams be associated with the recurring ex-

penses of different competing systems/bids. Additionally, the NPV method can also be applied to alternative leasing arrangements.

- The following are elements of this methodology:

  - First and foremost, it is important to establish a firm forecast of capital expenditures and recurring expenditures as supplied by the vendor and as associated with the maintenance agreement and in-house labor involvement. Not only should such estimates be established with great accuracy, but they should also be consistent with the requirements identified by each vendor's system.

  - Since no forecast can be completely accurate, it is necessary to adjust the capital and expense numbers for inflation, ± 10% for inaccuracy and for contingency purposes.

  - A planning horizon of at least seven to ten years should be established for purposes of calculating the NPV.

  - All fully loaded cost elements associated with user in-house expenditures should be added on to the recurring expenses identified by the system vendors.

  - All tax benefits associated with this investment, e.g., investment tax credit, should be estimated for each year and credited against net cash flow for each year of the system planning horizon.

  - Based on the method of financing (e.g., internal cost of capital in case of financing from retained earnings or external rate of interest according to the financing terms), an appropriate discount rate should be established to calculate the NPV and should be uniformly applied to all vendor systems.

- As indicated before, since some of this work can be reasonably tedious and time consuming, it is INPUT's recommendation that such work should be performed by trained financial analysts in the user's finance department.

- After the preliminary inputs have been established, the NPV of the life cycle cost should be calculated for each system and ranked according to different vendors.

- The above values of the NPV would provide the users with the best possible idea of what each system would cost in total during its lifetime and how each system total cost would compare with similar costs to the other competing systems. Additionally, a ± 10% sensitivity analysis would provide an even better perspective of life cycle comparison. It should be noted that ± 10% sensitivity analysis would not uniformly increase/decrease the NPV of each system by 10% because the time incidence of expenditures for each system would be different from one another. In fact, it is INPUT's experience that a sensitivity analysis sometimes provides a better perspective on cash outlays than does a straight NPV analysis.

- An important point that needs to be recognized by each use is that NPV life cycle cost analysis is extremely important in LAN/CBX planning decisions because low/high initial acquisition costs tend to be offset by high/low recurring costs. Consequently, the systems that may appear to be cheaper in the short-run may turn out to be the costliest in the long run and vice versa.

- The above merely indicates an important variable to be considered in the planning process. This must be weighed against other technical and operational issues as mentioned earlier in this report.

VII CONCLUSIONS AND RECOMMENDATIONS

VII CONCLUSIONS AND RECOMMENDATIONS

A. THE NEED FOR IN-HOUSE DILIGENCE

- Users and telecom/IS managers are now more accountable for designing, implementing, and managing the corporate network. Critical decisions must be made that require formalized planning, careful evaluation, participation by all affected parties, objective information, and the use of outside consultants when indicated.

- Sole reliance on the vendor (now represented by a wide range of suppliers and systems integrators) for information and advice, needs to be reevaluated in light of the range of choices, the expense, and the magnitude of the decisions that must be made.

- Telecom/IS managers must practice in-house diligence, filtering information from a variety of sources and accepting responsibility for their recommendations. They will have greater confidence in their recommendations after a careful planning process as outlined in this report.

B. TIMING CONSIDERATIONS

- There may be a tendency on the part of decision makers to "wait" for an announcement of the product that will establish the anticipated standard--de facto or otherwise. This may be the final clarification of IBM's intentions, or the next technological innovation.

- As has been the case in the adoption of other rapidly advancing technology, this wait may not be justified. New technology tends to become less expensive as more systems are installed and economies of scale come into effect. System "bugs" tend to be worked out over time as new technologies are field proven. However, the failure to adopt productivity-enhancing tools has costs in today's dollars. This too must be factored in the decision process.

- This underlines the importance of timing. Adoption of a technology is justified when the user is convinced that the state-of-the-art-technology matches the company's needs and when the financial analysis indicates that a cost-effective solution is at hand.

- There may also be internal timing considerations. Financial resources may or may not be presently available. Or they may be available now, but availability in the future is in doubt. In addition, the political climate may be favorable for implementing a corporate network solution now.

- The convergence of opportunities, requirements, and product capabilities can be as much a matter of luck as it is of planning. The telecom/IS manager is wise to observe and exploit favorable conditions.

C. CONCLUSIONS AND OBSERVATIONS

- The deregulation of the telecommunications industry has created a confusing environment for users.

- The one-step shopping of the past has been replaced with a complex choice of options and competitive dynamics that further obfuscate the industry.

- The competitive environment has created for the telecommunications user both risks and opportunities to improve the productivity of the firm.

- The corporate telecommunications function is being viewed as a corporate asset, requiring increased management skills from administrators and planners.

- Advancing technology offers cost-effective, yet capital-intensive solutions to office-of-the-future networking problems.

- The evolution of local area networks and third- and fourth-generation CBXs creates opportunities for integrating voice and data, and for adding building services such as energy control and security systems, thereby creating a cost-reducing, productive synergy of systems.

- A systems approach to designing, implementing, and managing the corporate telecommunications network is therefore required.

D. RECOMMENDATIONS

- Users and planners need to consider all appropriate options available (i.e., PBX, PBX, Data CBX, LAN, and fourth-generation CBX). These options must be matched to the corporate network needs now and in the future, and they must consider a wide variety of issues--technical, financial, political.

- The telecommunications strategy must be part of the corporate long-range plan. The success of recommendations will be enhanced by adopting the language and goals of the corporate plan to the network plan.

- Adapting the steps, procedures, and approaches outlined in this report to the user's specific requirements and conditions will lead to higher quality decisions, greater confidence in those decisions, and a greater chance of success in implementing the chosen telecommunications plan.

APPENDIX A: DEFINITIONS

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- ACD, Automatic Call Distribution - A method of distributing incoming calls according to a preestablished formula based on idle time of stations and other considerations. Typically used in an incoming telemarketing setting.

- Bridge - An interfacing link between similar LANs.

- Camp-On - A system, provided by some telephone systems, that queues callers when a busy condition exists, connecting them as the line becomes available.

- CDR, Call Detail Recording - A feature of CBXs that provides a detailed record of calls made. It can include station identification on each call, area code and number called, type of trunk used (direct distance dialing, WATS, foreign exchange), the date, time, duration, and any special billing or authorization codes. See also SMDR.

- CBX, Computerized Branch Exchange - A business telecommunications system that is programmable-software controlled.

- CPU, Central Processing Unit - The part of a computer system that does numeric operations, controls the sytem, provides timing signals, and does other logical operations.

- CO, Central Office - Typically, a telephone company installation where subscriber telephone line switching is done.

- Coax or Coaxial Cable - A transmission cable containing a conductor that surrounds another, separated by a continuous solid dielectric or by spacing materials. It is not susceptible to external interference and does not radiate.

- Coded - From coder/decoder, an electronic component that converts analog voice to digital data and back again.

- DDS, Dataphone Digital Service - A Bell System service that transmits data in digital rather than analog form.

- DTE, Data Terminal Equipment - Consists of the data source, link, or both, such as computer terminals.

- Diagnostics - Software and procedures used to isolate system problems.

- DTMF, Dual Tone Multifreuqnecy - A signalling method, called "Touch Tone," by the Bell System.

- EMS, Electronic Mail System - A computer-based messaging system, available on the network, or through gateways, to outside networks such as Telex.

- FAX, Facsimile - Equipment on which images are scanned, transmitted as impulses, reconfigured as images, and duplicated on paper. Essentially, these are communicating photocopy machines.

- Fiber Optic Cable - A transmission line made of bundled glass fibers.

- FX, Foreign Exchange - A trunk link provided by a common carrier from an exchange other than the local exchange.

- Gateway - An interfacing link between incompatible networks, typically from the private network or LAN to a public network.

- LAN, Local Area Network - A system allowing communications and equipment sharing within a building, intrabuilding, and intercampus.

- LCR, Least Cost Routing - A software supported function that routes outgoing calls the cheapest way, considering time of day, prices of alternative carriers, and network traffic.

- Modem - From modulate/demodulate. Converts analog signals to digital and back, for transmission on systems designed to handle voice.

- MUX, Multiplexer - A device that assigns data streams to different channels within one pathway.

- Node - A point of connection to a network where a number of terminals, circuits, or devices are attached.

- Nonblocking - A transmission network design so that the total number of transmission paths equals the number of ports, allowing all ports to access the network simultaneously.

- Packet - A group of data bits including control elements, which is switched and transmitted as a unit.

- Packet Switched Network - A system on which a channel is used to transfer addressed packets to many destinations, using time division multiplexing techniques (see TDM).

- PBX, Private Branch Exchange - A private telephone switching system that transmits calls internally, and out to the public telephone network.

- Polling - An access method whereby the master station (CPU or controller) essentially "asks" each station if it has traffic to send.

- Port - An interface on a computer or CBX where equipment is attached.

- Protocols - A set of standards used to format and provide timing of the message exchange between two communications systems.

- Protocol Converter - A device that converts dissimilar formats and relative timing of messages between different systems that use different standards.

- PCM, Pulse Code Modulation - A technique in which an analog signal is sampled. The magnitude of each sample is quantized and that value is converted into a digital signal.

- Remote Diagnostics - A method of isolating network problems from locations other than the user's location.

- Self-Diagnostics - Verifies integrity of the system automatically, reporting discrepancies and malfunctions.

- Speed Calling - A feature that allows telephone users to program frequently called numbers that are triggered by using a one-or two-digit access code.

- SMDR, Station Message Detail Record - Similar to CDR (above), refers to a standard format used by the Bell System for traffic and cost reporting.

- Telex - An international teletypewriter exchange using defined protocols and format.

- Terminal - Any device that sends and/or receives information over a communications channel. CRTs and telephones are two examples.

- Trunk - A single circuit, typically between switching centers, that handles many channels simultaneously.

- UCD, Uniform Call Distribution - Similar to ACD (above), distributes incoming calls to stations sequentially.

- USF, Voice and Forward, Voice Mail - A system that digitizes and stores voice for transmission, manipulation, and later retrieval. A form of electronic mail.

- X.25 - An international standard describing interfaces on a packet-switched network.

APPENDIX B: CBX PRODUCT PROFILES

APPENDIX B: CBX PRODUCT PROFILES

- Profiles are given here for comparison purposes. New products, product features, and capabilities are announced by vendors almost daily. Prices are given when available, but users are cautioned that prices are subject to change. Regardless, costs of a system specifically designed for the user's requirements are best compared based on detailed vendor proposals.

A. AMERICAN TELECOM

- The FOCUS series offers electronic display terminals, ACDs, account and authorization code features, LCR, and SMDR/CDR. The company has announced plans to offer integrated voice/data capabilities and a central controller capacity to manage office automation equipment.

- Redundancy is offered on configurations of more than one cabinet, allowing automatic control transfer in case one system fails.

- Capacity: 96-1,512 lines.

B. SYSTEM 75

- This third-generation product of the deregulated AT&T Information Systems was introduced in May 1984. It may replace its predecessor, the System 85. When coupled with the Information Systems Network LAN, the configuration offers fourth-generation capabilities. Workstations are the company's 3B family of computers.

- The system supports various digital terminals and analog telephone sets. It features ETN and DCS network compatibility, 3270 and 2780/3780 terminal emulation, 212A modem pooling and protocol conversion from digital DCP to analog, and menu-driven system management.

- Capacity: 64-1,800 lines.

- Cost: $860-960 per station, not including installation or wiring.

C. CXC CORPORATION - ROSE

- Features 80-character LCD with integrated keyboard, architecture able to handle switched video, and energy/security management.

- The system features dynamic bandwidth allocation and ring topology.

- Capacity: Up to 12,000 lines.

- The company has committed to IBM's LAN standards, when issued. When token ring standards are implemented, existing Ethernet packet bus will be discontinued but technology will be used as a gateway to Ethernet-compatible networks.

D. ERICSSON COMMUNICATIONS - PRODIGY

- The Prodigy features integrated voice/data, conferencing, remote diagnostics, and a fully modular design.

- Capacity: The system's 512 ports can be configured for lines (two each port) or for trunks (two ports for each trunk).

E. ERICSSON INFORMATION SYSTEMS - MD 110

- The MD 110 integrates voice and data on one pair of cable. The system has a distributed, "star/star" architecture, packet switching, and local area network interfaces.

- Because of the distribution of intelligent modules, it is highly redundant. Remote modules up to 600 miles away may be connected to the system.

- The MD 110 is the basis of the Honeywell Delta-Plex Series 2000, a product of a Honeywell-Ericsson joint venture.

- Capacity: 20,000+ ports.

F. GTE COMMUNICATIONS SYSTEMS - OMNI AND GTD SERIES

- GTE offers a family of integrated voice/data PBXs and the Action-Station terminal manufactured by Sydis.

- Systems are available for hospitality, hospital, and other special applications. Most features are available.

- Capacity: 50 to 50,000 lines.

- Cost: $600-700 per line.

G. HARRIS - DIGITAL TELEPHONE SYSTEMS

- This division offers the Harris 400 which features a basic data interface or line driver. Although a new entry, the company has not announced enhanced data features as of this writing.

- Capacity: 50-400 lines.

- Cost: $500 per line.

H. HITACHI AMERICA

- The company offers the Welcomm DX series, combined with the Constant Touch voice store and forward system produced by BBL Industries. The system is targeted to the hospitality industry.

I. ITT

- The System 3100 offers integrated voice/data abbreviated dialing, remote programmability with diagnostics, message waiting features, and modular

growth. Instruments feature alarm clock, automatic recall, music on hold, paging, distinctive ringing, group hunting, toll restriction, and other features. An office automation controller is currently not available.

- Capacity: 288 ports.

J. INTECOM - IBX

- Intecom offers the integrated business exchanges (IBX) in S/10, S/20 and S/40 models. It integrates voice/data with twisted pair LAN called the LANmark, and it allows dissimilar devices to communicate through integrated protocol and format conversion.

- IBX also features centralized modem pooling and access to public networks, hardware redundancy, on-line diagnostics, digital instruments, workstations with RS-232C, and other interfaces. Fiber optics links exist between cabinets. The system can provide switching capabilities at distant company locations.

- IBX has voice-synthesized instructions and InteMail voice messaging.

- Features can be provided optionally on a per-station basis.

- Uniform alternative routing (least cost routing) and call detail recording are featured. The directory lookup service option is user definable. Uniform call distribution is integrated.

- The company, a unit of Exxon, has a joint venture with Wang. IBX has format conversion between selected word processors, plus 3270 emulation, and X.25 and T-1 interface.

- The IBX-T offers user group partitioning of functions and features into up to 1,000 separate groups, in a shared tenant application.

- The LANmark allows data devices to send 10-Mbps burst packets of data, first with LANmark Ethernet. IBM 3270 coax replacement is planned. LANmark supports 8,000+ workstations.

- Capacity: Up to 8,192 ports in incremental expansion. Line and trunk circuits can be assigned to any available ports.

- Cost: $1,000 per voice/data port.

K. MITEL - SX-2000

- First introduced in 1982, this integrated voice/data switch has undergone additional software development.

- The company offers the Superset and Dataset series plus the Kontact executive workstation.

- Capacity: 16 voice and 16 data ports. Largest system installed supports 2,000 lines; however, the company says the architecture allows the system to evolve into a global network, LAN, or data network linked by various carriers.

- The company also offers the Superswitch family of PBXs in various configurations.

L. NEC - NEAX-2400 INFORMATION MANAGEMENT SYSTEM (IMS)

- Features available include EMS, voice mail and FAX modules, and store and forward systems, all integrated with voice communications. Feature modules stack, rather than being rack or cabinet mounted.

- The company offers the Dterm series of digital multifunction station instruments, with LCD display, key telephone emulation, and digital data interface. It uses twisted pair and fiber optics. The maintenance administration terminal provides system management. Pooled modems, integrated format, and protocal conversions are also featured.

- Capacity: 184-20,000+ ports.

M. NORTHERN TELECOM - SL

- The SL series of digital systems includes a data packet switch and the ESN (electronic switched network), which can link with the series (or with other vendors' systems), to provide networks to link from 2 to 100 locations.

- Each system integrates voice messaging, ASCII/3270 protocol conversion, 3270 coaxial eliminator, and support of various terminals and office automation systems.

- They can be configured for hospitality industry and may also be configured for military installation with AUTOVON operation.

- The company also provides the SL-1 series of instruments and the Displayphone voice/data terminal, which integrates a CRT, keyboard, and telephone.

- Capacity: 32-30,000 lines.

- Cost: $600-1,200 per line.

N. OKI

- The Spectrum series of fully digital, integrated voice/data systems offers central control for office automation applications. The design is nonblocking and fully redundant. Advanced systems (Spectrum 700, 4000) are fully digital with electronic instruments.

- Spectrum 700 and 4000 can serve up to four tenant groups.

- Capacity: 128-4,096 lines.

O. ROLM - CBX II

- CBX II replaces the earlier CBX line and features fully distributed processing and fiber optic links. It is totally digital, modular for upgrade ease, multinodal, has an integrated LAN and a dynamically allocatable bandwidth (DAB). It handles 4.4 billion bits per second and is extremely fault tolerant. PhoneMail USF is available. Redundant hardware is featured. Rolm IBM Gateway offers an interface between asynch terminals and IBM mainframe. X.25 interface and T1/D3 interfaces are available.

- Capacity: 25-10,000+ lines.

- It is fully compatible with the older CBX line. It has introduced a new processor, backplane, and internodal buses. The CBX II offers data broadcasting and hi-speed multiplexing.

- It may be configured for banking, hospitality, retail, hospital, and military settings. LCR, SMDR, central attendant service, ACD, call cost manager software, and resale manager software is available.

- Cost: Approximately $800 per line.

P. SIEMENS - SATURN II AND III

- This integrated voice/data system offers a new Office Communications II data feature package.

- Other features are day/night class of service, call hold flip-flop (brokers call) and attendant overflow, as well as the standard features found on equipment of this class.

- The company's electronic telephone set is the Digital Premium Instrument, but the system will support other sets.

- Capacity: Up to 224,992 lines on 1,024 ports.

Q. STOMBERG-CARLSON

- This company was formed in 1983 by Plessey Office Systems and was acquired from Stomberg. It offers the Progress CDSS (Computerized Digital Switching System).

- Capacity: 64-252 lines.

R. TEKNEKRON - INFOSWITCH

- A new entry, formed in 1983, markets products formerly handled by Datapoint, including the ISX (Information Switching Exchange) said by some to be the first fourth-generation CBX.

S. TELENOVA I

- This system is designed to fill a niche and minimize technical expertise in installation, maintenance, and service. The attractive, sleek station-set styling may be a consideration for adoption in some settings.

- It features simultaneous voice/data, integrated speaker phone; five soft keys; a help key; a 40-character, 2-line LCD; optional RS 232-C interface on the station set; an automatic message response; redial of last four numbers; conferencing; transfer; forward; and other features.

- There are interfaces for data (up to four devices each), central office (up to four CD trunks), and up to eight standard rotary/tone sets.

- The system identifies internal callers by name and extension, provides directory, menus, and prompting.

- Remote diagnostics is featured. The company says users can generally replace failed circuit assemblies without a technician.

- Capacity: Ten to 100 instruments. Non-blocking for up to 120 voice/data ports.

- Interface units are being developed for LAN, T-1, X.25, and video transmission connections.

- A library of software diskettes allows custom configuration to vertical industries.

- Cost: Approximately $1,000 per line, but the cost should be coming down with offshore manufacture.

T. TIE

- The company's Mercury offers triple redundancy, T-1 carrier interfaces, data terminal interfaces, conferencing, remote or local change capability, and built-in traffic analysis. The fully integrated system offers office automation equipment centralized control.

- Capacity: 1,920 lines.

U. UNITED TECHNOLOGIES

- Through the Lexar division, the company offers the UTX 1200 and 5000. The switch has a nonblocking architecture, toll restriction capability, CDR functions, and links with the company's electronic instruments.

- Capacity: Up to 5,376 lines and trunks.

V. ZTEL - PRIVATE NETWORK EXCHANGE (PNX)

- Adding a new term (PNX) to the telecommunications lexicon, Ztel offers an integrated PBX and high-speed token-passing LAN integrating voice, data, video, and FAX.

- More than 150 features available including call detail recording, least-cost routing, on-line directory, and attendant operations. Internal callers are identified. Automatic load sharing is also featured.

- Executive management Telset has a 40-character LCD and 28 programmable soft keys. The basic station offers a 12-key programmable pad, no display, and optional RS 232C or RS 449 interface connectors. Also available is digital, single-line set.

- Capacity: 128 system consoles (attendant, messaging, administration/maintenance) for up to 20,000 lines.

- The company has committed to direct connection with IBM's LAN standard upon issuance.

- Systems processing units would normally contain applications, switching, and data conversion processing. Units might alternatively be dedicated to one type of processing, for example, data or word processing.

- Cost: $800 per line.

APPENDIX C: LAN PRODUCT PROFILES

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- The same cautions prefacing the CBX profiles apply to these LAN profiles. New features, capabilities, and prices are announced daily. Although pricing information is given (when available), the best cost comparisons are those based on vendor proposals.

A. APOLLO COMPUTER - DOMAIN

- The product, DOMAIN, stands for Distributed Operating Multi-Access Interactive Network.
- A token-passing, baseband system with ring topology, the system is configured for scientific, CAD/CAM, and other specialized applications.

B. APPLE COMPUTER - APPLENET

- A baseband network using CSMA/CD and Xerox network protocols supporting the Apple family of computers.
- Allows for file and peripheral sharing.
- Cost: Approximately $500 per connection.

C. APPLITEK CORPORATION - UNILAN, UNILINK

- Offering a system that can be implemented on baseband, broadband, or fiber optics, the UniLINK uses an adaptable message division access method. The system supports digitized voice, file transfer, and terminal transmissions.

D. AT&T INFORMATION SYSTEMS - INFORMATION SYSTEMS NETWORK

- Announced in July 1984 (general availability scheduled for January 1985), AT&T's entry is designed to be fully integrated with its other products.

- Features twisted pair or coax and is available with a fiber optic backbone. Technology is based on the Datakit. Centralized short bus, separate contention bus, internal timing, channel address translator. Topology is the same as IBM's Cabling System. 3270 emulation and protocol conversion options. System 75 and 85 PBX are used to integrate voice.

- Capacity: Initially available configured for more than 1,600 devices. Smaller configurations to be announced.

- Gateways to other LANs will be developed "as appropriate." Promises Lightwave System, fiber optic backbone, replacing coax. Supporting groups of workstations to be announced. Interfaces for high-speed PC to LAN connection. Ethernet, T-1, and X.25 interfaces scheduled for mid-1985 release. Also coming is fiber optic link to DEC VAX series.

- Dual, short bus architecture and 8086-controlled perfect scheduling method avoids packet collisions. Can be configured for local, campus, and national applications.

- Cost: $390-500 per port.

E. CONCORD DATA SYSTEMS - TOKEN/NET

- A baseband system using coax cable, this system has a practical maximum of 20 miles. Offers general office automation and manufacturing applications.
- Cost: $500-2,000 per connection.

F. CONTEL INFORMATION SYSTEMS - CONTELNET, STAR-ELEVEN

- ConTelNet is a broadband system that can initially be installed as a baseband system. Gateways to Ethernet and other LANs are available. Maximum practical network length of one mile.
- Applied to distributed data/word processing; switched video; conferencing; and host-to-host, high-speed file transferring.
- The company also offers Star-Eleven, a twisted pair star configuration primarily for host computer access. Primary applications are for multiuser real-time processing in campus and industrial settings.

G. CORVUS SYSTEMS - OMNINET

- A broadband network using twisted pair, this LAN is designed to connect micros and peripherals.
- Cost: Approximately $500 per interface.

H. DATA GENERAL CORPORATION - XODIAC

- Baseband, token-passing system with X.25 and SNA capabilities. Supports a company's CEO and other office automation. Text-graphic applications.
- Cost: $4,500 per computer including connectors, transceivers.

I. DATAPOINT CORPORATION - ARCNET

- The LAN for the company's Attached Resources Computer Systems. Manufacturing and other special software is available.
- Capacity: Up to 5,500 terminals.
- Cost: $400 per port.

J. DESTEK GROUP - DESNET

- A baseband system that offers optional boards for broadband, fiber optic, or twisted pair connections. Interface boards are available for various types of PCs. Can run cable to four miles and up to 350 nodes of various equipment.
- Cost: Interface boards approximately $600.

K. DIGITAL EQUIPMENT CORPORATION - DECAWAY, ETHERNET

- DECaway connects terminals and other equipment to VAX-11 computers for real-time applications and large-scale data processing in various industrial settings.

- Cost: Approximately $4,000 per connection (Ethernet).

L. DIGITAL MICROSYSTEMS - HINET

- A microcomputer network connecting the company's CP/M systems on a dual twisted pair cable.

- Cost: $1,600-4,500 per connection, including the workstation and software.

M. HEWLETT-PACKARD - INTERFACE BUS

- Designed for factory, lab, and office settings, the baseband system connects local devices to a central HP controller. Fiber optics extend capacity.

- Cost: Interface controlling eight stations is $2,000.

N. INTERACTIVE SYSTEMS/3M - VIDEODATA LAN/1

- Using CATV cable, the system can integrate analog voice and full-motion video, along with handling general office automation and data processing needs.

- Connects with hardware from DEC, Hewlett-Packard, IBM, and any RS-232-C device.

- Capacity: 10,000+ stations.

- Cost: $500-700 per connection, but is priced by number of ports. Includes frequency translator, software, and training.

O. LOGICA - POLYNET

- The Cambridge ring system is designed for settings where sequence-critical applications are used. Allows connection to DEC's PDP-11 minicomputers, and to Intel and other systems.

- Company offers gateways to several large mainframe systems.

- Cost: $1,000 per connection.

P. M/A-COM DCC - INFOBUS

- A broadband LAN using coax cable in a dual design, the system is specifically designed to handle data/voice and video.

- Can be used in hospital settings and in general office automation environments.

Q. NCR - NCR DECISION NET

- Uses Corvus' Omninet with NCR's Modus file-sharing system, designed to link NCR's line of workstations and devices, as well as Apple and IBM equipment.
- Designed for office automations and CP/M applications.
- Cost: $500-700 per connection.

R. NESTAR SYSTEMS - PLAN

- Designed for general office automation and instructional settings, the base-band system connects various PCs.
- Cost: $595 per connection.

S. NETWORK SYSTEMS CORPORATION - HYPERCHANNEL

- Designed to handle high-speed, bulk-packetized data between mainframes and supercomputers. The system is installed in financial, manufacturing, airline, and scientific settings.
- Will connect with Cray, IBM, and other large mainframes.
- Can link through satellite or microwave channels.
- Cost: $12,000-40,000 per computer port.

T. ORCHID TECHNOLOGY

- A general purpose LAN designed to link IBM and IBM-clone systems.
- Cost: $695 per connection.

U. PRIME COMPUTER - RINGNET

- A baseband system for distributed processing environments, the system will support up to 250 node controllers in a ring configuration, each node supported by a Prime computer, and each node supporting 128 workstations.
- Cost: $5,000 per connection with node controller.

V. PROLINK - PROLOOP

- A baseband system for voice communications and data/word processing, the typical system will include the company's workstation and CBX.

W. SYTEK, INC. - LOCALNET 20

- Uses CATV broadband standard distribution techniques. Features distributed network intelligence. Optional data encryption for security. Remote diagnostics and automatic self-test facilities. Optional packet communications units. X.25, Ethernet, and fiber optic gateways or bridges available.

- Capacity: 20,000+ connections. Simultaneous data communications uses.
- Cost: $475-575 per computer connection.

X. 3COM CORPORATION - ETHERNET/UNET, ETHERLINK

- UNET designed for UNIX and UNIX-clone environments, supporting up to 1,000 mainframe computers. It will also link with any Ethernet-type network.
- Cost: $2,000-3,000 per computer connection.
- Etherlink is for connecting IBM PCs in office automation environments.
- Cost: approximately $950 per connection.

Y. UNGERMANN-BASS: NET/ONE

- One of the first to offer LANs, the company has broadband, baseband, and fiber optic systems. Offers bridges between them. User programmable. Gateways to Burroughs BNA, DEC DNA, Honeywell, IBM SNA, Sperry, and Telenet (X.25). Company offers cable design, installation, and testing services.
- Capacity: Up to 36,000 devices.
- Cost: $400-750 per connection (broadband/baseband), $475-850 (fiber optic).

Z. WANG - WANGNET

- A broadband system designed to connect the company's office automation equipment, including video capabilities, with seven video channels.

AA. XEROX CORPORATION - ETHERNET

- A baseband network that can support as many as 1,024 stations. The CSMA/CD access method was adopted as an industry standard.
- Supports distributed data/word processing applications and other office automation systems on Xerox systems. Supported by Intel, DEC, and other manufacturers.
- Offers gateways to remote workstations, IBM protocols, or other networks.
- Capacity: 1,024 stations. Future products.
- IBM's cabling system.
- Not yet a LAN, IBM's announced system of six shielded copper pairs, fiber optics cables, wall faceplates, and connectors is the beginning of what some think will become a de facto standard for a token-ring LAN.
- Seen as a step in product development, with a full LAN (or LANs) scheduled for announcement in the 1986-87 time frame. Best suited for new building installation.
- Company has tested with several CBX systems.

- Cost: From $0.40 to $0.65 a foot for twisted-pair cables, to $3 per foot for optical cable. Faceplates are $3-4, data connectors are $11.38, and voice connectors are $8.24. Volume prices are available from authorized dealers.